

SECTION TABLE OF CONTENTS

DIVISION 02 - SITE WORK

SECTION 02220

DEMOLITION

04/01

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 GENERAL REQUIREMENTS
- 1.3 SUBMITTALS
- 1.4 DUST CONTROL
- 1.5 PROTECTION
 - 1.5.1 Protection of Personnel
 - 1.5.2 Protection of Structures
 - 1.5.3 Protection of Existing Property
 - 1.5.4 Protection From the Weather
 - 1.5.5 Protection of Trees
 - 1.5.6 Environmental Protection
- 1.6 BURNING
- 1.7 USE OF EXPLOSIVES

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

- 3.1 EXISTING STRUCTURES
- 3.2 UTILITIES
 - 3.2.1 Utility Services
- 3.3 FILLING
- 3.4 DISPOSITION OF MATERIAL
 - 3.4.1 Salvageable Items and Material
 - 3.4.1.1 Material Salvaged for the Contractor
 - 3.4.1.2 Items Salvaged for Reuse
 - 3.4.2 Unsalvageable Material
- 3.5 CLEAN UP
- 3.6 PAVEMENTS

-- End of Section Table of Contents --

SECTION 02220

DEMOLITION

04/01

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

ENGINEERING MANUALS (EM)

EM 385-1-1 (1996) U.S. Army Corps of Engineers Safety and Health Requirements Manual

1.2 GENERAL REQUIREMENTS

The work includes demolition, salvage of identified items and materials, and removal of resulting rubbish and debris. Rubbish and debris shall be removed from project site daily, unless otherwise directed, to avoid accumulation at the demolition site. Materials that cannot be removed daily shall be stored in areas specified by the Contracting Officer. In the interest of occupational safety and health, the work shall be performed in accordance with EM 385-1-1, Section 23, Demolition, and other applicable Sections. In the interest of conservation, salvage shall be pursued to the maximum extent possible; salvaged items and materials shall be disposed of as specified.

1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with SECTION 01330: SUBMITTAL PROCEDURES:

SD-08 Statements

Work Plan; GA.

The procedures proposed for the accomplishment of the work. The procedures shall provide for safe conduct of the work, including procedures and methods to provide necessary supports, lateral bracing and shoring when required, careful removal and disposition of materials specified to be salvaged, protection of property which is to remain undisturbed, coordination with other work in progress, and timely disconnection of utility services. The procedures shall include a detailed description of the methods and equipment to be used for each operation, and the sequence

of operations in accordance with EM 385-1-1.

1.4 DUST CONTROL

The amount of dust resulting from demolition shall be controlled to prevent the spread of dust to occupied portions of the construction site and to avoid creation of a nuisance in the surrounding area. Use of water will not be permitted when it will result in, or create, hazardous or objectionable conditions such as ice, flooding and pollution.

1.5 PROTECTION

1.5.1 Protection of Personnel

During the demolition work the Contractor shall continuously evaluate the condition of the structure being demolished and take immediate action to protect all personnel working in and around the demolition site. No area, section, or component of floors, roofs, walls, columns, pilasters, or other structural element will be allowed to be left standing without sufficient bracing, shoring, or lateral support to prevent collapse or failure while workmen remove debris or perform other work in the immediate area.

1.5.2 Protection of Structures

Floors, roofs, walls, columns, pilasters, and other structural components that are designed and constructed to stand without lateral support or shoring, and are determined to be in stable condition, shall remain standing without additional bracing, shoring, or lateral support until demolished, unless directed otherwise by the Contracting Officer. The Contractor shall ensure that no elements determined to be unstable are left unsupported and shall be responsible for placing and securing bracing, shoring, or lateral supports as may be required as a result of any cutting, removal, or demolition work performed under this contract.

1.5.3 Protection of Existing Property

Before beginning any demolition work, the Contractor shall survey the site and examine the drawings and specifications to determine the extent of the work. The Contractor shall take necessary precautions to avoid damage to existing items to remain in place or be reused; any damaged items shall be repaired or replaced as approved by the Contracting Officer. The Contractor shall coordinate the work of this section with all other work and shall construct and maintain shoring, bracing, and supports as required. The Contractor shall ensure that structural elements are not overloaded and shall be responsible for increasing structural supports or adding new supports as may be required as a result of any cutting, removal, or demolition work performed under this contract.

1.5.4 Protection From the Weather

Salvageable materials and equipment shall be protected from the weather at all times.

1.5.5 Protection of Trees

Trees within the project site which might be damaged during demolition, and which are indicated by the Contracting Officer to be left in place, shall be protected by a 4 foot high fence as specified in SECTION 01000: GENERAL.

Any tree designated to remain that is damaged during the work under this contract shall be replaced in kind or as approved by the Contracting Officer.

1.5.6 Environmental Protection

The work shall comply with the requirements of SECTION 01410: ENVIRONMENTAL PROTECTION.

1.6 BURNING

The use of burning at the project site for the disposal of refuse and debris will not be permitted.

1.7 USE OF EXPLOSIVES

Use of explosives will not be permitted.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.1 EXISTING STRUCTURES

Existing structures indicated on plans to be removed shall be removed. The location and approximate plan dimension of the principal items to be removed are listed in Table A attached at the end of this Section. In general, minor structures are not shown and the Contractor is expected to examine the work site, prior to bidding to determine the character and extent of such structures. All above ground structures, not listed separately at the end of this section and required to be removed to construct the permanent features shall be removed as part of the work to which the removal pertains. Removal of structures, not shown or specified for removal, for the convenience of the Contractor will be subject to approval.

Interior walls, other than retaining walls and partitions, shall be removed to 10.0 feet below grade. Basement slabs, foundations, and miscellaneous debris from sites where homes have previously been removed shall be removed as specified in SECTION 02300 EARTHWORK. Streets and parking lot pavement and base courses, sidewalks, curbs, gutters, driveways, and street light bases shall be removed as indicated.

Abandoned water mains, storm and sanitary sewer lines and other utilities that go through or under the levees shall be removed in their entirety within the levee prism, unless otherwise shown, and plugged or capped outside of the levee prism as specified below. Abandoned water mains, storm and sanitary sewer lines and other utilities outside of the levee footprint may be plugged by filling with sand or grout and capped or

removed as indicated or as approved by the Contracting Officer. The water main, storm and sanitary sewer plugs shall be inspected and approved by the City of East Grand Forks Utility Department prior to backfilling. The contact at the City is Mark Kotbra, (218) 773-1313.

3.2 UTILITIES

When utility lines are encountered that are not indicated on the drawings, the Contracting Officer shall be notified prior to further work in that area.

3.2.1 Utility Services

Utility services are not indicated on the drawings. Services have been abandoned from homes that have been removed, however the services of homes have typically not been removed. The Contractor will encounter utility services of homes that have been removed while performing the work of this contract. The Contractor shall remove services as specified in Paragraph: Existing Structures.

3.3 FILLING

Holes, open basements and other hazardous openings shall be filled in accordance with SECTION 02300: EARTHWORK.

3.4 DISPOSITION OF MATERIAL

Title to material and equipment to be demolished, except salvage and historical items, is vested in the Contractor upon receipt of notice to proceed. The Government will not be responsible for the condition, loss or damage to such property after notice to proceed.

3.4.1 Salvageable Items and Material

Contractor shall salvage items and material to the maximum extent possible.

Hydrants, light posts and lights, and park shelters to be removed shall be salvaged and remain the property of the City of East Grand Forks. Salvaged hydrants and light posts shall be delivered to the City of East Grand Forks Water and Light Department at a site to be determined within the City of East Grand Forks. Removed park shelters shall be disassembled, salvaged, and stockpiled on site out of the way of construction operations, for reinstallation by others in the future.

3.4.1.1 Material Salvaged for the Contractor

Material salvaged for the Contractor shall be stored as approved by the Contracting Officer and shall be removed from the project site before completion of the contract. Material salvaged for the Contractor shall not be sold on the site.

3.4.1.2 Items Salvaged for Reuse

Salvaged items to be reused shall be removed and delivered or stockpiled in a manner to prevent damage and protect from damage while in storage. The

Contractor will not be responsible for salvaged items after delivery or stockpiling.

3.4.2 Unsalvageable Material

Concrete, masonry, and other noncombustible material, except concrete permitted to remain in place, shall be disposed off-site at a site selected by the Contractor.

3.5 CLEAN UP

Debris and rubbish shall be removed from basement and similar excavations. Debris shall be removed and transported in a manner that prevents spillage on streets or adjacent areas. Local regulations regarding hauling and disposal shall apply.

3.6 PAVEMENTS

Existing pavements designated for removal shall be saw cut and removed in accordance with the details shown on the drawings.

-- End of Section --

TABLE A
SCHEDULE OF STRUCTURES TO BE REMOVED
REACH 1

Approx. Location Station(s)	Offset	Item Structure	Qty.	Unit
Bituminous Pavement				
D55+00- D57+69			2482	SF
12th Street			19733	SF
12th Street		Driveways	5755	SF
8th Avenue		Driveways	3405	SF
10th Street NW		Driveways	2145	SF
10th Street NW		Roadway	14954	SF
Sherlock Park		Roadway	48240	SF
Storm Sewer				
D66+50		Plug 42" RCP	1	EA
D66+50		Plug 33" RCP	1	EA
D66+50		Manhole	1	EA
D66+50		33" RCP	490	LF
D90+50		48" RCP	410	LF
D91+80		Plug 48" RCP	1	EA
D92+00		Culvert	23	LF
D103+50		30" PVC	200	LF
Profile Station 0+00 (Dwg. 64/232)		30" VCP Outlet		LF
Concrete Curb and Gutter				
12th Street		Curb and Gutter	793	LF

TABLE A
SCHEDULE OF STRUCTURES TO BE REMOVED
REACH 1

Approx. Location Station(s)	Offset	Item Structure	Qty.	Unit
Concrete Sidewalk				
12th Street		North Side	2324	SF
12th Street		South Side	2734	SF
8th Avenue			1464	SF
10th Street			1321	SF
Aggregate Surfacing				
Alley between 12th Street and Hwy 2			5974	SF
Driveways between 12th Street and Hwy 2			3656	SF
Buildings/Structures				
Sherlock Park		5 Park Shelter structures	3737	SF
Water Line				
D84+50		6" Cast Iron Pipe		LF
Sanitary Sewer				
4th St. NW (Profile Station 7+78, 64/230A)		Sanitary Sewer		LF
Profile Sta. 20+35 (Dwg. 64/231)		Sanitary Sewer		LF

TABLE A
SCHEDULE OF STRUCTURES TO BE REMOVED
REACH 2

Approx. Location Station(s)	Offset	Item Structure	Qty.	Unit
Storm Sewer:				
126+50	253' R	24" RCP Flared End Section	1	EA
126+35	308' R-338' R	24" CMP	30	LF
126+50	140' R-255' R	24" RCP	115	LF
126+45- 126+59	45' L-52' L	Concrete Drainage Structure 14' x 7' x 17' deep	1	EA
126+15- 126+45	10' L-45' L	24" RCP	55	LF
126+20- 126+60	65' L-55' L	24" RCP	30	LF
126+50	45' L-140' R	24" RCP	185	LF
Bituminous Pavement				
126+60	325' R	670' Bike Path	6300	SF
126+20- 127+20	80' L-105' L	Road	2575	SF
Concrete Curb and Gutter				
126+20- 127+20	80' L	Curb and Gutter	115	LF
Concrete Pavement				
126+40- 127+20	75' L-80' L	Concrete Pavement	400	SF

TABLE A
SCHEDULE OF STRUCTURES TO BE REMOVED
REACH 3

Approx. Location Station(s)	Offset	Item Structure	Qty.	Unit
Sanitary Sewer				
40+55	120' L	Manhole	1	EA
41+30	140' L	Manhole	1	EA
42+50	130' L	Manhole	1	EA
40+60- 42+90	120' L-130' L	8" Vitrified Clay Pipe	370	LF
40+85	20' L	Manhole	1	EA
43+20	10' R	Manhole	1	EA
40+85- 46+00	20' L - 5' R	8" Vitrified Clay Pipe	500	LF
46+00- 49+80	10' R-100' L	8" PVC Pipe	350	LF
46+70	10' R	Manhole	1	EA
46+90	10' L	Manhole	1	EA
47+45- 48+10	55' R- 60' L	12" Forcemain	120	LF
47+40- 48+10	95' R- 25' L	8" PVC Pipe	100	LF
48+10	25' L	Manhole	1	EA
55+05	5' R	Manhole	1	EA
55+05	105' L- 5' R	Pipe (size and type unknown)	107	LF
55+05- 56+15	5' R- 95' L	Pipe (size and type unknown)	208	LF
210+15	10' L	Manhole	1	EA
210+15- 214+20	10' L	8" Vitrified Clay Pipe	400	LF
214+20- 215+80	15' L- 5' R	8" Vitrified Clay Pipe	170	LF

TABLE A
SCHEDULE OF STRUCTURES TO BE REMOVED
REACH 3

Approx. Location Station(s)	Offset	Item Structure	Qty.	Unit
Sanitary Sewer-Continued				
215+90	15' R	Manhole	1	EA
217+45	0'	Manhole	1	EA
215+70- 217+45	45' R-0'	Pipe (size and type unknown)	210	LF
217+45	0'-40' R	Pipe (size and type unknown)	40	LF
214+20- 215+75	0'	6" Cast Iron Pipe	155	LF
Storm Sewer				
41+00	145' L	Manhole	1	EA
41+00	250' L	Manhole	1	EA
41+00	250' L - 150' L	12" RCP	35	LF
41+50	145' L	Catch Basin	1	EA
41+50	115' L	Manhole	1	EA
41+00- 41+50	150' L-115' L	12" RCP	185	LF
47+45	170' R	Reconnect Catch Basin	1	EA
49+25	85' R	Reconnect Catch Basin	1	EA
54+00	50' R	Reconnect Catch Basin	1	EA
54+25	85' R	Manhole	1	EA
54+25	190' R-500' L	12" RCP	698	LF
57+15- 61+20	200' R-280' R	12" RCP	320	LF
60+30	240' R	Manhole	1	EA
61+20- 61+50	280' R-290' R	12" RCP	35	LF

TABLE A
SCHEDULE OF STRUCTURES TO BE REMOVED
REACH 3

Approx. Location Station(s)	Offset	Item Structure	Qty.	Unit
Storm Sewer-Continued				
61+50	290' R	Manhole	1	EA
62+20	260' R	Catch Basin	1	EA
72+30	300' R	Culvert	34	LF
83+05- 84+00	240' L- 5' R	12" RCP	270	LF
83+85	40' L	Manhole	1	EA
84+00	5' R	Catch Basin	1	EA
92+50	210' R	Catch Basin, Salvage and Adjust	1	EA
92+50	250' R	Catch Basin, Salvage and Adjust	1	EA
92+10- 92+50	245' R	12" RCP	55	LF
92+50	210' R-250' R	12" RCP	40	LF
98+65	70' R	Manhole	1	EA
98+65	70' R-285' L	27" RCP	350	LF
98+65	285' L	Manhole	1	EA
98+65	285' L-535' L	18" RCP	250	LF
98+40	285' L	Catch Basin	1	EA
98+40- 98+65	285' L	12" RCP	30	LF
98+65- 98+78	240' L-285' L	12" RCP	45	LF
98+65- 98+75	70' R-85' R	12" RCP, Salvage and Reconnect	15	LF
98+65- 99+12	70' R-87' R	12" RCP, Salvage and Reconnect	50	LF

TABLE A
SCHEDULE OF STRUCTURES TO BE REMOVED
REACH 3

Approx. Location Station(s)	Offset	Item Structure	Qty.	Unit
Storm Sewer-Continued				
98+65- 102+20	70' R	12" RCP	350	LF
98+78	240' L	Catch Basin	1	EA
99+12	47' R	Catch Basin, Salvage and Adjust	1	EA
99+12	87' R	Catch Basin, Salvage and Adjust	1	EA
99+12	47' R-87' R	12" RCP, Salvage and Reconnect	40	LF
102+20	70' R	Manhole	1	EA
102+20- 102+30	70' R-85' R	12" RCP, Salvage and Reconnect	15	LF
102+20- 102+40	70' R-60' R	12" RCP, Salvage and Reconnect	20	LF
164+00	10' L	Catch Basin	1	EA
210+25	20' R	Catch Basin	1	EA
213+35	20' R	Catch Basin	1	EA
217+55	10' L	Manhole	1	EA
219+05	18' L	Catch Basin	1	EA
219+05	18' R	Catch Basin	1	EA
215+65- 219+05	45' R-10' L	12" RCP	370	LF
217+55	10' L-30' R	12" RCP	40	LF
219+05	18' L-18' R	12" RCP	36	LF
Water Line				
40+00- 43+30	75' L-150' L	6" Cast Iron Pipe	510	LF
40+40	150' L	Hydrant	1	EA
43+55	5' L	Hydrant	1	EA

TABLE A
SCHEDULE OF STRUCTURES TO BE REMOVED
REACH 3

Approx. Location Station(s)	Offset	Item Structure	Qty.	Unit
Water Line-Continued				
43+30- 43+55	50' L -5' L	6" Cast Iron Pipe	50	LF
98+30	40' L-305' L	6" Cast Iron Pipe	390	LF
98+15	305' L	Fire Hydrant	1	EA
209+40- 214+20	0'	6" Cast Iron Pipe	480	LF
210+15	15' R	Hydrant	1	EA
214+20- 215+75	0' R	6" Cast Iron Pipe	155	LF
Gas Line				
40+00- 42+80	50' L-120' L	2" Steel Pipe	400	LF
40+00- 46+00	100' R-165' R	2" Steel Pipe	610	LF
46+00- 56+50	165' R-130' L	2" Steel Pipe	1090	LF
98+30	40' L-225' L	2" Steel Pipe	265	LF
Bituminous Pavement				
Timberline Court		Bituminous Pavement	31240	SF
40+00- 46+00	100' R-175' R	3rd Ave. SE Bit. Pavement	2950	SF
46+00- 54+60	175' R-140' R	Bituminous Pavement	12970	SF
58+00- 58+60	20' R-20' L	Bituminous Pavement	2200	SF
59+85- 60+25	60' R-60' L	Bituminous Pavement	4600	SF
67+00 +/-		Trail from Ex. Shelter	7200	SF

TABLE A
SCHEDULE OF STRUCTURES TO BE REMOVED
REACH 3

Approx. Location Station(s)	Offset	Item Structure	Qty.	Unit
Bituminous Pavement-Continued				
83+30- 88+00	110' R-55' L	Bituminous Pavement	28150	SF
90+00- 91+95	85' L-40' L	Bituminous Trail	1980	SF
91+90- 92+30	250' R-0' L	Bituminous Pavement	9120	SF
93+00- 102+50	50' R-90' R	Bituminous Pavement	36400	SF
98+40- 98+80	50' R-295' L	Bituminous Pavement	13800	SF
160+00- 177+72	30' R-10' L	Bituminous Pavement	7140	SF
202+40- 209+70	5' R-5' L	Bituminous Trail	6830	SF
203+00- 214+20	20' R-20' L	Bituminous Pavement	17175	SF
214+20- 215+80	20' R-20' L	Bituminous Pavement	6400	SF
215+80- 219+05	18' R-18' L	Bituminous Pavement	12600	SF
219+05- 223+00	10'	Bituminous Trail	5650	SF
Concrete Pavement				
40+00- 41+90	80' R-200' R	Concrete Pavement	1185	SF
40+20	145' L	Concrete Pavement	150	SF
40+45	90' L	Concrete Pavement	225	SF
41+00	170' L	Concrete Pavement	175	SF

TABLE A
SCHEDULE OF STRUCTURES TO BE REMOVED
REACH 3

Approx. Location Station(s)	Offset	Item Structure	Qty.	Unit
Concrete Pavement-Continued				
41+20	170' L	Concrete Pavement	200	SF
41+40	170' L	Concrete Pavement	300	SF
42+00	155' L	Concrete Pavement	200	SF
42+30	95' L	Concrete Pavement	250	SF
42+70	125' L	Concrete Pavement	250	SF
43+15	80' L	Concrete Pavement	200	SF
43+30	20' L	Concrete Pavement	225	SF
43+30	30' R	Concrete Pavement	125	SF
44+10- 46+00	160' R	Concrete Pavement	1585	SF
46+00- 47+70	155' R	Concrete Pavement	817	SF
49+00- 54+10	90' R-40' R	Concrete Pavement	3334	SF
54+20- 56+75	490' R-95' L	Concrete Pavement	33529	SF
57+95	20' R-20' L	Concrete Pavement	200	SF
58+65	20' R-20' L	Concrete Pavement	200	SF
59+80	60' R-60' L	Concrete Pavement	575	SF
60+30	60' R-60' L	Concrete Pavement	575	SF
67+00	60' R	Conc. Pavement at Park Shelter	1260	SF
83+30- 88+00	115' R-75' L	Concrete Pavement	9445	SF
126+00	8' R	Concrete Pavement	750	SF

TABLE A
SCHEDULE OF STRUCTURES TO BE REMOVED
REACH 3

Approx. Location Station(s)	Offset	Item Structure	Qty.	Unit
Concrete Pavement-Continued				
90+00- 91+90	160' R-190' R	Concrete Pavement	1685	SF
95+00- 101+80	30' R	Concrete Pavement	5593	SF
98+20	30' R-295' L	Concrete Pavement	2110	SF
98+95	30' R-185' L	Concrete Pavement	1400	SF
124+70-				
124+00- 127+85	8' R	Concrete Pavement	2400	SF
176+20- 177+50	18' R	Concrete Pavement	640	SF
200+00	0'	Concrete Pavement	100	SF
210+15- 214+20	28' R+22' L	Concrete Pavement	4450	SF
214+20- 215+75	28' R	Concrete Pavement	875	SF
214+20- 215+75	28' L	Concrete Pavement	1040	SF
215+75- 217+10	65' R-23' R	Concrete Pavement	1000	SF
216+00- 217+70	23' L	Concrete Pavement	940	SF
Concrete Curb and Gutter				
Timberline Court		Curb and Gutter	1405	LF
40+00- 41+50	100' R-170' R	Curb and Gutter	105	LF

TABLE A
SCHEDULE OF STRUCTURES TO BE REMOVED
REACH 3

Approx. Location Station(s)	Offset	Item Structure	Qty.	Unit
Concrete Curb and Gutter-Continued				
41+85- 42+80	170' R	Curb and Gutter	90	LF
43+30- 44+10	170' R	Curb and Gutter	70	LF
44+30- 44+90	170' R	Curb and Gutter	60	LF
45+30- 46+00	170' R	Curb and Gutter	70	LF
46+00- 46+30	170' R	Curb and Gutter	30	LF
46+55- 47+80	170' R	Curb and Gutter	120	LF
49+15- 49+80	85' R-50' R	Curb and Gutter	130	LF
50+00- 51+90	50' R	Curb and Gutter	190	LF
52+00- 52+55	50' R	Curb and Gutter	55	LF
52+80- 54+50	50' R	Curb and Gutter	170	LF
54+20- 56+75	440' R-95' L	Curb and Gutter	1184	LF
54+40- 54+70	135' R	Curb and Gutter	30	LF
57+95	20' R-20' L	Curb and Gutter	40	LF
58+70	20' R-20' L	Curb and Gutter	40	LF
59+85	60' L-60' R	Curb and Gutter	120	LF
60+25	60' L-60' R	Curb and Gutter	120	LF

TABLE A
SCHEDULE OF STRUCTURES TO BE REMOVED
REACH 3

Approx. Location Station(s)	Offset	Item Structure	Qty.	Unit
Concrete Curb and Gutter-Continued				
83+30- 88+00	110' R-60' L	Curb and Gutter	1115	LF
91+90	205' R-5' L	Curb and Gutter	210	LF
92+30- 93+00	10' R-250' R	Curb and Gutter	165	LF
93+00- 102+00	85' R	Curb and Gutter	750	LF
93+00- 98+30	50' R	Curb and Gutter	415	LF
98+40	40' R-295' L	Curb and Gutter	270	LF
98+80	40' R-295' L	Curb and Gutter	315	LF
98+40- 98+80	295' L	Curb and Gutter	40	LF
127+70- 127+85	18' R	Curb and Gutter	15	LF
176+30- 177+00	10' L	Curb and Gutter	70	LF
177+50- 177+72	10' L	Curb and Gutter	30	LF
176+10- 177+72	35' R	Curb and Gutter	170	LF
200+00	10' R-10' L	Curb and Gutter	20	LF
209+70- 214+20	20' L	Curb and Gutter	405	LF

TABLE A
SCHEDULE OF STRUCTURES TO BE REMOVED
REACH 3

Approx. Location Station(s)	Offset	Item Structure	Qty.	Unit
Concrete Curb and Gutter-Continued				
210+15- 214+20	20' R	Curb and Gutter	335	LF
214+20- 215+75	20' R	Curb and Gutter	115	LF
214+20- 215+75	20' L	Curb and Gutter	120	LF
215+75- 219+05	18' R	Curb and Gutter	270	LF
215+75- 219+05	18' L	Curb and Gutter	310	LF
Aggregate Surfacing				
Veterans Memorial Arena Entrance Road		Class 5	15400	SF
Buildings/Structures				
67+00	60' R	Park Shelter	1	EA

SECTION TABLE OF CONTENTS

DIVISION 02 - SITE WORK

SECTION 02230

CLEARING AND GRUBBING

04/01

PART 1 GENERAL

1.1 DEFINITIONS

1.1.1 Clearing

1.1.2 Grubbing

1.1.3 Clearing and Grubbing Limits

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION

3.1 CLEARING

3.2 GRUBBING

3.3 TREE REMOVAL

3.4 DISPOSAL OF MATERIALS

3.4.1 Materials Other Than Salable Timber

3.5 ACCEPTANCE

-- End of Section Table of Contents --

SECTION 02230

CLEARING AND GRUBBING

04/01

PART 1 GENERAL

1.1 DEFINITIONS

1.1.1 Clearing

Clearing shall consist of the felling, trimming, and cutting of trees into sections and the satisfactory disposal of the trees and other vegetation designated for removal, including down timber, snags, brush, and rubbish occurring in the areas to be cleared.

1.1.2 Grubbing

Grubbing shall consist of the removal and disposal of stumps, roots larger than 3 inches in diameter, and matted roots from the designated grubbing areas.

1.1.3 Clearing and Grubbing Limits

The Contractor shall assume that clearing and grubbing shall be performed on all trees, stumps, and other vegetation, described above, within the work limits indicated. The Contractor shall give the Contracting Officer a minimum of 72 hours of notice of commencing clearing and grubbing operations. The Contracting Officer will mark trees, brush, and other vegetation within the work limits that are to be saved and not cleared and grubbed.

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION

3.1 CLEARING

Trees, stumps, roots, brush, and other vegetation in areas to be cleared shall be cut off flush with or below the original ground surface, except such trees and vegetation as may be indicated or directed to be left standing. Trees and vegetation to be left standing shall be protected from damage incident to clearing, grubbing, and construction operations by the erection of barriers or by such other means as the circumstances require as specified in SECTION 02220: DEMOLITION, and SECTION 01000: GENERAL.

Limbs of trees designated to be left standing within the cleared areas that are damaged by construction operations shall be trimmed. Limbs and branches to be trimmed shall be neatly cut close to the bole of the tree or main branches. Cuts more than 1-1/2 inches in any dimension shall be painted with an approved tree-wound paint.

3.2 GRUBBING

Material to be grubbed, together with logs and other organic or metallic debris not suitable for foundation purposes, shall be removed to a depth of not less than 18 inches below the original surface level of the ground in areas indicated to be grubbed and in areas indicated as construction areas under this contract, such as areas for buildings and levees, and areas to be paved. Depressions made by grubbing shall be filled with suitable material and compacted to make the surface conform with the original adjacent surface of the ground.

3.3 TREE REMOVAL

Where indicated or directed by the Contracting Officer, trees and stumps shall be removed from areas outside those areas designated for clearing and grubbing. This work shall include the felling of such trees and the removal of their stumps and roots as specified in paragraph GRUBBING. Trees shall be disposed of as specified in paragraph DISPOSAL OF MATERIALS.

3.4 DISPOSAL OF MATERIALS

3.4.1 Materials Other Than Salable Timber

Logs, stumps, roots, brush, rotten wood, and other refuse from the clearing and grubbing operations, except for salable timber, shall be disposed of outside the limits of Government-controlled land at the Contractor's responsibility, except when otherwise directed in writing. Such directive will state the conditions covering the disposal of such products and will also state the areas in which they may be placed.

3.5 ACCEPTANCE

Upon completion of the site clearing, obtain the Contracting Officer's acceptance of the extent of clearing and grubbing.

-- End of Section --

SECTION TABLE OF CONTENTS

DIVISION 02 - SITE WORK

SECTION 02290

GEOTECHNICAL MONITORING SYSTEMS

04/01

PART 1 GENERAL

- 1.1 SCOPE
- 1.2 RELATED WORK OF OTHER SECTIONS
- 1.3 REFERENCES
- 1.4 SUBMITTALS

PART 2 PRODUCTS

- 2.1 MATERIALS
 - 2.1.1 Plastic Pipe for Settlement Gage Risers
 - 2.1.2 Plastic Pipe Couplings
 - 2.1.3 Solvent Cement
 - 2.1.4 Steel Pipe for Settlement Gages
 - 2.1.5 Settlement Gage Base Plate

PART 3 EXECUTION

- 3.1 PREPARATION
- 3.2 INSTRUMENTATION INSTALLATION
 - 3.2.1 Order Of Work
 - 3.2.2 Settlement Gage Installation
- 3.3 QUALITY CONTROL

-- End of Section Table of Contents --

SECTION 02290

GEOTECHNICAL MONITORING SYSTEMS
04/01

PART 1 GENERAL

1.1 SCOPE

This section consists of systems to monitor soil settlement and includes the following:

- a. Furnish, install, and survey settlement gages.
- b. Coordination with Contracting Officer's representative during installation of monitoring systems and embankment material.

1.2 RELATED WORK OF OTHER SECTIONS

The following items of related work are covered under other sections:

- 1) Clearing and Grubbing: SECTION 02230: CLEARING AND GRUBBING.
- 2) Placement of Embankment: SECTION 02300: EARTHWORK.

1.3 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 53	(1990, Revision B) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
ASTM A 276	(1992) Stainless and Heat Resisting Steel Bars and Shapes
ASTM D 1785	(1992) Poly (Vinyl Chloride) PVC Plastic Pipe, Schedules 40, 80, and 120
ASTM D 2564	(1991, Revision A) Solvent Cements for Poly (Vinyl Chloride) PVC Plastic Piping Systems

1.4 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The

following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-01 Data

Product Data; GA

Material catalog cuts of steel and plastic piping and related elbows, and other incidental items.

SD-08 Statements

Testing Laboratory Statment; GA

Submit name, location, and qualification of testing laboratory or firm.

Filling Plan; GA

Submit plan for filling as it relates to geotechnical monitoring systems in accordance with SECTION 02300: EARTHWORK.

SD-09 Reports

Settlement Gage Readings; FIO

Submit settlement gage readings within 24 hours of obtaining readings. Submission shall be on a form(s) of the Contractor's choosing, but shall contain all previous readings for each settlement gage.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Plastic Pipe for Settlement Gage Risers

Shall be PVC, rigid, ASTM D 1785, Schedule 40. Size as shown.

2.1.2 Plastic Pipe Couplings

Shall be PVC, ASTM D 1785, Schedule 40, slip or threaded couplings for the pipe sizes indicated on the drawings.

2.1.3 Solvent Cement

Shall be in accordance with ASTM D 2564.

2.1.4 Steel Pipe for Settlement Gages

Shall meet the requirements of ASTM A 53 - B.

2.1.5 Settlement Gage Base Plate

Shall be marine-grade plywood.

PART 3 EXECUTION

3.1 PREPARATION

Excavate areas to receive settlement gages. Tamp excavation bottom with hand tamper to level surface to receive settlement gage.

3.2 INSTRUMENTATION INSTALLATION

3.2.1 Order Of Work

Install settlement gages prior to placing fill within 100 feet of the particular settlement gage in question. Do not install settlement gages more than 36 hours prior to placing embankment fill at the site.

3.2.2 Settlement Gage Installation

Three settlement gages shall be provided as shown and maintained as required herein. The stations of the three locations are Station D89+00, Station D92+40, and Station F77+00. The settlement gages shall be installed 5 feet riverward of the levee centerline. Each base plate shall be placed on the prepared surface of foundation material. After initial placement of the gage, install 12 inches of fill near the plate to stabilize the gage. The Contractor shall determine the elevations of the base plates and x-y coordinates of the top of the riser pipes before fill placement and continue to take elevation and x-y coordinate readings. During embankment construction, the settlement gages shall be surveyed weekly, prior to the placement of any additional fill and each time a section of riser pipe is added to a settlement gage, until completion of the embankment construction. After the embankment has been completed, the settlement areas shall be surveyed monthly until the end of the contract. The Contractor is responsible for adding riser pipe and the protective plastic casing. The elevation and x-y coordinates of the stem shall be determined immediately before and immediately after each extension is added. These elevations will be verified by the Contracting Officer. Care must be taken to install the stem plumb. The Contractor shall extend the stem in increments as the embankment rises but at no time shall the top of the stem be lower than one-foot above the surface of the embankment. The Contractor shall conduct its operations in such a manner that installed settlement gages are neither disturbed nor damaged. Suitable markers shall be placed around the gages for protection. Fill around the stem shall be compacted to the same density and moisture content as the surrounding material. Each settlement gage disturbed, damaged, or destroyed due to fault or negligence on the part of the Contractor shall be restored or replaced, as directed by the Contracting Officer, by the Contractor and at no additional cost to the Government. No additional payment will be made for compaction of fill around the settlement gages or for interference with the Contractor's operations resulting from the settlement gage measurement requirements or installations.

3.3 QUALITY CONTROL

The Contractor shall establish and maintain quality control for work under

this section to assure compliance with contract requirements and maintain records of his quality control for all construction operations including, but not limited to the following:

- 1) Compaction
- 2) Settlement gage instrumentation installation
- 3) Settlement gage instrumentation survey readings

A copy of the records of inspections and tests, as well as the records of corrective action taken shall be furnished to the Government as directed by the Contracting Officer.

-- End of Section --

SECTION TABLE OF CONTENTS

DIVISION 02 - SITE WORK

SECTION 02300

EARTHWORK

04/01

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 SUBMITTALS
- 1.3 SUBSURFACE DATA
- 1.4 ALTERNATE BORROW SOURCES AND EVALUATION
- 1.5 ALTERNATE SOURCES
 - 1.5.1 Evaluation by Site Inspection
 - 1.5.2 Evaluation by Test Data

PART 2 PRODUCTS

- 2.1 DEFINITIONS
 - 2.1.1 Satisfactory Materials
 - 2.1.2 Cohesionless and Cohesive Materials
 - 2.1.3 Proctor
- 2.2 MATERIALS
 - 2.2.1 Common Borrow
 - 2.2.2 Select Granular Fill
 - 2.2.3 Granular Fill
 - 2.2.4 Impervious Fill
 - 2.2.5 Select Impervious Fill
 - 2.2.6 Random Fill
- 2.3 CONSTRUCTION EQUIPMENT
 - 2.3.1 Dams and Levees

PART 3 EXECUTION

- 3.1 CLASSIFICATION OF SOIL MATERIALS
- 3.2 Stockpiles
- 3.3 STRIPPING OF TOPSOIL
- 3.4 EXCAVATION AND BORROW PITS
 - 3.4.1 Changes and Differing Site Conditions
- 3.5 DITCHES, GUTTERS, AND CHANNEL CHANGES
- 3.6 BORROW MATERIAL
 - 3.6.1 Excavation and Borrow Pits
 - 3.6.1.1 Restoration of Borrow Areas
 - 3.6.2 Utilization of Excavated Materials
- 3.7 EMBANKMENTS
- 3.8 STRUCTURES
- 3.9 LEVEES

- 3.9.1 Embankment
- 3.9.2 Inspection Trench
 - 3.9.2.1 Inspection Trench Excavation and Observation
 - 3.9.2.2 Inspection Trench Backfill
 - 3.9.2.3 Inspection Trench Location
- 3.10 SUBGRADE PREPARATION
 - 3.10.1 Subgrade Correction
- 3.11 FINISHING
 - 3.11.1 Pavement Subgrade Tolerances
- 3.12 PLACING TOPSOIL
- 3.13 COMPACTION
 - 3.13.1 Moisture Control
 - 3.13.2 Placement and Compaction
- 3.14 TESTING
 - 3.14.1 General
 - 3.14.2 Field Density Tests
 - 3.14.3 Proctor Tests
 - 3.14.4 Treatment of Oversize Particles for Density Tests
 - 3.14.5 Corrective Action
 - 3.14.6 Testing Schedule
- 3.15 NUCLEAR DENSITY TESTING EQUIPMENT
- 3.16 SUBGRADE AND EMBANKMENT PROTECTION

-- End of Section Table of Contents --

SECTION 02300

EARTHWORK

04/01

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 117	(1995) Materials Finer Than 75 Micrometers (No. 200 Sieve) in Mineral Aggregates by Washing
ASTM C 136	(1996a) Sieve Analysis of Fine and Coarse Aggregates
ASTM D 422	(1963; R 1998) Particle-Size Analysis of Soils
ASTM D 698	(1991; R 1998) Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft ³ (600 kN-m/m ³))
ASTM D 1140	(1997) Amount of Material in Soils Finer than the No. 200 (75-micrometer) Sieve
ASTM D 1556	(1990; R 1996) Density and Unit Weight of Soil in Place by the Sand-Cone Method
ASTM D 1557	(1998) Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/cu. ft. (2,700 kN-m/cu. m.))
ASTM D 2167	(1994) Density and Unit Weight of Soil in Place by the Rubber Balloon Method
ASTM D 2487	(1998) Classification of Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D 2488	(1993) Practice for Description and Identification of Soils (Visual-Manual

Procedure)

ASTM D 2922	(1996) Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
ASTM D 2937	(1994) Density of Soil in Place by the Drive-Cylinder Method
ASTM D 3017	(1988; R 1996el) Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)
ASTM D 4318	(1998) Liquid Limit, Plastic Limit, and Plasticity Index of Soils
ASTM D 4718	(1987; R 1994) Correction of Unit Weight and Water Content for Soils Containing Oversize Particles

1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having a "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-09 Reports

Testing; FIO.

A summary of testing results indicated in PARAGRAPH: TESTING shall be submitted when the site work is substantially complete. The Contracting Officer shall be informed of test results daily for direction on corrective action required. Draft copies of field testing results shall be furnished to the Contracting Officer on a frequent and regular basis as directed, but do not need to be formally transmitted through the submittal process.

Daily Report Forms;FIO.

A compilation of the daily report forms for earthwork observation and inspection trench observations ordered by date shall be submitted when the work is substantially complete. Preliminary copies shall be furnished to the Contracting Officer on a weekly or monthly basis as directed, but do not need to be formally transmitted through the submittal process.

1.3 SUBSURFACE DATA

Reference the Physical Data clause in SECTION 00800:

1.4 ALTERNATE BORROW SOURCES AND EVALUATION

Borrow materials shall be produced from the sources listed in SECTION 00830 : ATTACHMENTS. If the Contractor proposes to furnish materials from a source not listed, the Government will make such investigations and

evaluations as necessary to determine whether or not materials with acceptable characteristics can be obtained from the proposed source.

1.5 ALTERNATE SOURCES

1.5.1 Evaluation by Site Inspection

If the Contractor proposes to furnish borrow from an unlisted source, the Government will evaluate the alternate source and reply within 30 days. An investigation shall be performed by a Government geologist or engineer. The Contractor shall expose fresh soil for the full height of the face proposed for production during the field evaluation.

1.5.2 Evaluation by Test Data

If sufficient information is not available, the Government will reconsider the alternative source if evaluation is supplemented by sampling and testing of the properties specified for the material. If the Contractor wishes to pursue the alternate source, the Government will notify the Contractor of required sampling and number of tests required. The Contractor shall be responsible for sampling and testing costs for alternate sources. The Contracting Officer shall be present during the sampling, unless waived. Information provided with the samples shall include the location and elevation from which the sample was taken. Testing shall be completed by a laboratory approved in accordance with SECTION 01451: CONTRACTOR QUALITY CONTROL. Test results and jar samples shall be furnished to the Government geologist at the District Office. This will require a 14-day evaluation period after the test results are received at the District Office.

PART 2 PRODUCTS

2.1 DEFINITIONS

2.1.1 Satisfactory Materials

Satisfactory materials shall be of a character and quality satisfactory for the purpose intended, and meet the applicable material specifications.

2.1.2 Cohesionless and Cohesive Materials

Cohesionless materials include materials classified in ASTM D 2487 as GW, GP, SW and SP. Cohesive materials include materials classified as GC, SC, ML, CL, MH, and CH. Materials classified a GM and SM will be identified as cohesionless only when the fines are nonplastic.

2.1.3 Proctor

Degree of compaction required is expressed as a percentage of the maximum density obtained by the test procedure presented in ASTM D 698. The maximum density is hereafter abbreviated as the "Standard Proctor" or "Proctor" value. The optimum moisture content, w_o , is the water content at which the soil is compacted to the maximum density as determined during the test procedure presented in ASTM D 698.

2.2 MATERIALS

All material placed as fill or backfill shall consist of material classified by ASTM D 2487 as GW, GP, GC, GM, SP, SM, SC, CL, and SW. The material shall be free of ice, snow, frozen earth, trash, debris, sod, roots, organic matter, or stones larger than 3 inches in any dimension.

2.2.1 Common Borrow

Common borrow shall have less than 40% retained on the No. 4 sieve, and less than 30% retained on the 3/4" sieve.

2.2.2 Select Granular Fill

Select granular fill shall meet requirements for common borrow and shall contain not more than 5% by weight of material passing the No. 200 sieve. The maximum allowable aggregate size shall be 1-1/2 inches.

2.2.3 Granular Fill

Granular fill shall meet requirements for common borrow and shall contain not more than 12% by weight of material passing the No. 200 sieve.

2.2.4 Impervious Fill

Impervious fill shall meet requirements for common borrow and shall have a plasticity index less than 50 and classified by ASTM D 2487 as CL or CH.

2.2.5 Select Impervious Fill

Select impervious fill shall meet requirements for common borrow, shall have a plasticity index less than 30, a clay fraction less than 40% by weight finer than 0.002 mm and classified by ASTM D 2487 as CL or CH.

2.2.6 Random Fill

Random fill shall consist of native materials meeting the requirements for common borrow.

2.3 CONSTRUCTION EQUIPMENT

Compaction equipment shall consist of sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, or other approved equipment well suited to the soil type being compacted. Water flooding or jetting methods of compaction will not be permitted for any soil types. Sprinkling equipment for cohesive soils shall apply water uniformly, in controlled quantities and be capable of variable application widths.

2.3.1 Dams and Levees

Use of sheepsfoot rollers (vibratory or non-vibratory), or scarification

between lifts, is required for construction of dams, dikes, or levees (any water retaining structures). Construction equipment and methods shall avoid poor bonding between lifts, characterized by layered or laminated texture at the lift interfaces. Smooth surfaces (such as produced from smooth drum rollers, rubber-tired rollers, and construction traffic) shall be scarified prior to placing subsequent lifts.

PART 3 EXECUTION

3.1 CLASSIFICATION OF SOIL MATERIALS

Classification of soil materials shall be performed by the Contractor in accordance with ASTM D 2488. The contracting Officer reserves the right to revise the Contractor classifications. In the case of disagreement, the Contracting Officer's classification will govern unless the soils are classified in accordance with ASTM D 2487. All testing completed by the Contractor in conjunction with soil material classification will be considered incidental to the contract work.

3.2 Stockpiles

Stockpiles shall be kept in a neat and well drained condition, giving due consideration to drainage at all times. The ground surface at stockpile locations shall be cleared, grubbed, and sealed. Satisfactory and unsatisfactory materials shall be separately stockpiled. Stockpiles of satisfactory materials shall be protected from contamination which may destroy the quality and fitness of the stockpiled material. If the Contractor fails to protect the stockpiles, and any material becomes contaminated, frozen or too wet for use, such material shall be removed and replaced with satisfactory material from approved sources at no additional cost to the Government.

3.3 STRIPPING OF TOPSOIL

Where indicated or directed, topsoil shall be stripped to a depth of 6 inches. Topsoil shall be spread on areas already graded and prepared for topsoil, or transported and deposited in stockpiles convenient to areas that are to receive application of the topsoil later, or at locations indicated or specified. Topsoil shall be kept separate from other excavated materials, brush, litter, objectionable weeds, roots, stones larger than 2-inches in diameter, and other materials that would interfere with planting and maintenance operations. Any surplus of topsoil from excavations and grading shall be removed from the site.

3.4 EXCAVATION AND BORROW PITS

After topsoil removal has been completed, excavation of every description, regardless of material encountered, within the grading limits of the project shall be performed to the lines and grades indicated. Excavation material suitable for use as fill shall be transported to and placed in fill areas within the limits of the work. All unsatisfactory material, including any soil which is disturbed by the Contractor's operations or softened due to exposure to the elements and water, and surplus material shall be disposed of in areas approved for off-site storage. Excavation

carried below the depths indicated shall be refilled to the proper grade with satisfactory material. During construction, excavation and fill shall be performed in a manner and sequence that will provide proper drainage at all times. Material required for fill or embankment in excess of that produced by excavation within the grading limits shall be excavated from the borrow areas indicated or from other approved areas selected by the Contractor as specified.

3.4.1 Changes and Differing Site Conditions

Any excavation subgrades that are unstable, pump, rut excessively, reveal soil conditions that are substantially different from that indicated in the contract, or are unsuitable for proceeding with the work shall immediately be reported to the Contracting Officer. In the event that it is necessary to remove material to a depth greater than specified, the Contracting Officer will provide direction for changed work; and an adjustment in the contract price will be considered in accordance with the contract. Unsatisfactory material encountered below the grades shown shall be removed as directed. Determination of elevations and measurements of approved overdepth excavation of unsatisfactory material below grades indicated shall be done under the direction of the Contracting Officer. The Contracting Officer shall be notified prior to proceeding with any unauthorized work. Additional work not authorized by the Contracting Officer shall be at the Contractor's expense.

3.5 DITCHES, GUTTERS, AND CHANNEL CHANGES

Ditches, gutter, and channel changes shall be cut accurately to the cross sections and grades indicated. Gutters and ditches shall be finished in a manner that will result in effective drainage. All roots, stumps, rock, and foreign matter in the sides and bottom of ditches, gutter, and channel changes shall be trimmed and dressed or removed to conform to the slope, grade, and shape of the section indicated. Care shall be taken not to excavate ditches and gutters below the grades indicated. Excessive ditch and gutter excavation shall be backfilled to grade with properly placed and compacted material. All ditches and gutters excavated under this section shall be maintained until final acceptance of the work. Satisfactory material excavated from ditches and channel changes shall be placed in fill areas.

3.6 BORROW MATERIAL

Borrow material shall be selected to meet the requirements and conditions of the particular fill or embankment for which it is to be used. Borrow material shall be obtained from the borrow areas shown, from removal of the existing levees as shown, or from other approved sources, either private or within the limits of the project site, selected by the Contractor. Material excavated from existing levees, except for stripping materials, shall be used as impervious fill as shown, unless otherwise directed. Unless otherwise provided in the contract, the Contractor shall obtain from the owners the right to procure material, pay royalties and other charges involved and bear the expense of developing the sources, including rights-of-way for hauling. Borrow material from approved sources on Government-controlled land may be obtained without payment of royalties.

Unless specifically provided, no borrow shall be obtained within the limits of the project site without prior written approval. Necessary clearing, grubbing, and drainage of borrow pits, disposal of debris thereon, and restoration shall be considered related operations to the borrow excavation.

3.6.1 Excavation and Borrow Pits

Except as otherwise permitted, borrow pits and other excavation areas shall be excavated providing adequate drainage. Overburden and other spoil material shall be transported to designated spoil areas or otherwise disposed of, or used for special purposes. Borrow pits shall be neatly trimmed and drained after the excavation is completed. The Contractor shall ensure that excavation of any area, operation of borrow pits, or dumping of spoil material results in minimum detrimental effects on natural environmental conditions.

3.6.1.1 Restoration of Borrow Areas

Upon completion of levee removal, removal areas shall be restored as shown or specified. Upon completion of excavation from indicated borrow areas, the bottom of the borrow areas shall be graded to provide free surface drainage and preclude ponding and erosion. Side slopes shall not be steeper than 1 vertical on 5 horizontal. Borrow areas shall be seeded with winter wheat if planted in the Spring or oats if planted in the Fall. Seed shall be placed at a rate of 20 pounds per acre.

3.6.2 Utilization of Excavated Materials

Material removed from excavations shall be incorporated in the work insofar as practicable. No excavated material that is satisfactory for use as fill shall be wasted without specific written authorization. Material authorized to be wasted shall be stored in designated areas approved for surplus material storage and disposed of offsite. No excavated material shall be disposed of in such a manner as to obstruct the flow of any stream, endanger a partly finished structure, impair the efficiency or appearance of any structure, or be detrimental to the complete work in any way.

3.7 EMBANKMENTS

Fills and embankments shall be constructed at the locations and to the lines and grades indicated. Fill shall meet the material specifications for the zones indicated on the drawings. The material shall be placed in successive horizontal layers for the full width of the cross section and shall be compacted as specified. Each layer shall be compacted before the overlaying lift is placed.

3.8 STRUCTURES

See SECTION 02315: EXCAVATION, FILLING AND BACKFILLING FOR STRUCTURES

3.9 LEVEES

3.9.1 Embankment

If not specifically identified, common borrow, random fill, or other unclassified material shall be sorted to the extent practicable with the more cohesive and less pervious material placed riverside, and sandy free-draining material placed landside.

3.9.2 Inspection Trench

The inspection trench will be used to locate undesirable subsurface features. Any pipes, tiles, conduits, buried debris, or other utilities that are indicated or specified for removal shall be removed from within the footprint of the levee and plugged outside of the levee limits as directed by the Contracting Officer. Unsatisfactory foundation materials encountered shall be removed from within the footprint of the levee as directed by the Contracting Officer. Utilities indicated or specified to remain in place shall be protected from damage during inspection trench operations. The Contractor shall notify the Contracting Officer 48 hours prior to start of this work. Observation shall be recorded on the daily report forms attached to this specification, or to a Contractor's special purpose form for observing trench excavations if approved by the Contracting Officer.

3.9.2.1 Inspection Trench Excavation and Observation

An inspection trench will be excavated as shown on the plans. Immediately after excavating the trench, the Contractor shall inspect and record the soil and water conditions encountered and any other pertinent features. Soils on the base and side slopes shall be identified in accordance with ASTM D 2488. In reaches where caving occurs, the Contractor shall either widen the trench, dewater to keep the trench stable, or assign a competent person to observe the excavation continuously in addition to the excavator operator. Excessive water seepage shall be removed to allow visual inspection. During construction of the inspection trench, the Contractor shall immediately notify the Contracting Officer in the event that soil conditions encountered differ significantly from those shown on the boring logs.

3.9.2.2 Inspection Trench Backfill

The Contracting Officer will observe the trench before backfilling, unless waived for trench stability reasons. All water and mud shall be removed from the trench before backfill is placed. The excavated material may be used for backfill only if it meets the material specified. All inspection trench backfill shall be placed in lifts and completed as specified in PARAGRAPH: COMPACTION.

3.9.2.3 Inspection Trench Location

The inspection trench shall generally be located close to the levee centerline. The inspection trench shall be continuous at all points, aligned with smooth curves, and free from abrupt changes in alignment. The Contracting Officer may direct the actual alignment of the inspection trench within the limits of the levee right of way to intercept suspect areas.

3.10 SUBGRADE PREPARATION

All areas upon which fill is to be placed shall be stripped before the fill is started. Material shall not be placed on surfaces that are muddy, frozen, contain frost, or where unsatisfactory material remains in or under the fill. For cohesionless soils, the subgrade surface shall be compacted to at least 100% of the Standard Proctor density. For cohesive soils, the subgrade shall be proof rolled with rubber-tired equipment and any soft areas shall be brought to the Contracting Officer's attention. Sloped ground surfaces steeper than one vertical to four horizontal on which fill is to be placed shall be stepped such that the fill material will bond with the existing surface.

3.10.1 Subgrade Correction

Soft or otherwise unsatisfactory material shall generally be removed and replaced with satisfactory excavated material or other approved material as directed. Low areas resulting from removal of unsatisfactory material shall be brought up to required grade with satisfactory materials, and the entire subgrade shall be shaped to line, grade, and cross section and compacted as specified.

3.11 FINISHING

All areas covered by the project, including excavated and filled sections and adjacent transition areas, shall be uniformly smooth-graded. The finished surface shall be reasonably smooth, compacted, and free from irregular surface changes. The degree of finish shall be that ordinarily obtainable from blade-grader operations, except as otherwise specified. Ditches and gutters shall be finished to permit adequate drainage. The surface of areas to be turfed shall be finished to a smoothness suitable for establishment of turf.

3.11.1 Pavement Subgrade Tolerances

When the final layer of base has been completed, and at the time any additional construction is to be placed thereon, the finished surface of the base shall not vary more than 0.05 feet from the plan elevation.

3.12 PLACING TOPSOIL

Topsoil placement is covered in SECTION: ESTABLISHMENT OF TURF.

3.13 COMPACTION

3.13.1 Moisture Control

Control of moisture in the fill shall be maintained to provide acceptable compaction. Dried or crusted cohesive soils shall be plowed, disked or otherwise broken up before compaction. If water is added to fills, the layer shall be spread in even lifts, moistened as necessary, thoroughly mixed, and compacted. Maintain moisture content for select impervious fill between $w_o - 3\%$ and $w_o + 1\%$ during placement and compaction.

3.13.2 Placement and Compaction

Each layer shall be spread uniformly. The type of fill, its maximum uncompacted lift thickness, and the minimum compaction requirements (Percent of Standard Proctor density) to which each type of fill shall be compacted shall be as listed below.

<u>Fill Zone</u>	<u>Maximum Uncompacted Lift Thickness (inches)</u>	<u>Percent of Standard Proctor Density</u>
General Grading (Random Fill)	12	90
Structure Subgrades Floor Slabs and Steps	9	100
Structure Backfill	12	95
Levees	12	95
Utility Backfill	See SECTION 02316: EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITY SYSTEMS	

a. Fill materials shall be placed in horizontal layers not exceeding 6 inches loose depth when hand-operated compactors are used.

b. Embankments and subgrade under pavements shall be compacted to at least the Percent of Standard Proctor density as follows:

(1) For fill sections the top 36 inches below the aggregate base course shall be placed in uncompacted lifts not exceeding 9 inches and compacted to at least 100% of Standard Proctor density.

(2) For cut sections in cohesionless soils the subgrade surface shall be compacted to at least 100% of Standard Proctor density. For cut sections in cohesive soils, the subgrade shall be proof rolled and any soft areas shall be brought to the Contracting Officer's attention.

3.14 TESTING

3.14.1 General

All testing expenses shall be the Contractor's responsibility. Prior to sampling and testing the work, testing laboratories shall be inspected and approved in accordance with SECTION 01451: CONTRACTOR QUALITY CONTROL. The Contracting Officer reserves the right to direct the location and select the material for samples to be tested and to direct where and when moisture-density tests shall be performed.

3.14.2 Field Density Tests

Report forms for summaries of field density tests shall include the minimum information. Additional data required by the applicable ASTM test methods shall be kept on file by the Contractor. Tests shall be numbered

sequentially throughout the job, and retests shall reference the original test number (1A, 1B, etc.):

1. Test Number.
2. Dry density, water content and gravel content of field test.
3. Proctor Number, maximum dry density, optimum water content, and gravel content.
4. Relative Compaction.
5. Each test shall be plotted on the graphic presentation of the applicable Proctor test.

3.14.3 Proctor Tests

Report forms for summaries of Proctor tests shall include the minimum information. Additional data required by the applicable ASTM test methods shall be kept on file by the Contractor. Jar samples shall be retained by the testing laboratory for each Proctor test until field testing is completed.

1. Test Number and method.
2. Sample location and visual soil description.
3. Maximum dry density, and optimum water content.
4. Gravel contents in sample and test specimens.

3.14.4 Treatment of Oversize Particles for Density Tests

The fine gravel contents shall be corrected by selecting an appropriate Proctor sample. The fine gravel content shall be the particles retained on the No. 4 sieve and passing the 3/4" sieve. The fine gravel content of the field density test shall be within + or - 5% of the fine gravel content of the Proctor sample.

The oversize fraction shall be particles retained on the 3/4" sieve. For oversize fractions greater than 5%, the oversize particles shall be corrected in accordance with the Finer Fraction Method specified in ASTM D 4718.

Each sand cone test shall report the gravel content retained on the No. 4, 3/8" and 3/4" sieve as appropriate for the Proctor method referenced.

Where nuclear testing is used and lack of uniformity in the soil due to layering, rock or voids are suspected, the test volume site shall be dug up and visually examined to determine if the test material is representative of the full material in general and if rock correction is required.

3.14.5 Corrective Action

Tests of materials which do not meet the contract requirements (failing test) will not be counted as part of the required testing. Each such failing test must be retaken at the same location as the failing test was taken. If testing indicates material does not meet the contract requirements, the material represented by the failing test shall not be placed in the contract work or shall be recompact or removed. The quantity of material represented by the failing test shall be determined by the Contracting Officer up to the quantity represented by the testing frequency. The Contractor may increase testing frequency in the vicinity of the failing test in order to reduce removal requirements, as approved by the Contracting Officer. Such increases in testing frequency shall be at the Contractor's expense and at no additional cost to the Government.

3.14.6 Testing Schedule

a. Moisture-Density Relations (ASTM D 698)

One test for each material variation, not less than 10 tests total.

b. In-Place Densities (ASTM D 1556 or ASTM D 2922)

(1) Typical, 1 test per 2000 CY of fill placed.

(2) Structure foundations and floor slabs. See SECTION 02315: EXCAVATION, FILLING, AND BACKFILLING FOR STRUCTURES.

(3) Utility trench backfill. See SECTION 02316: EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITY SYSTEMS

(4) Segmental Concrete Retaining Walls over 5-feet in height, not less than 1 test for each 2 vertical feet per 300 linear feet along wall face.

c. Percent Passing No. 200 sieve (ASTM C 117).

(1) Select Granular Fill, 1 test per 1000 CY of fill placed, not less than 1 test for each source placed.

(2) Granular Fill, 1 test per 5000 CY of fill placed, not less than 1 test for each source.

d. Sieve Analysis, (ASTM C 136)

(1) Select Granular Fill, 1 test for each source.

e. Plasticity Index (ASTM D4318)

(1) Cohesive soils, 1 test for each Proctor test.

(2) Impervious fill, 1 test per 5000 CY of fill.

(3) Select impervious fill, 1 test per 5000 CY of fill.

f. Clay Fraction (percent smaller than 0.002 mm, determined in

accordance with ASTM D 422)

- (1) Select impervious fill, 1 test per 5000 CY of fill.

3.15 NUCLEAR DENSITY TESTING EQUIPMENT

Nuclear density testing equipment shall be used in general accordance with ASTM D 2922 and ASTM D 3017. In addition, the following conditions shall apply:

a. Prior to using the nuclear density testing equipment on the site the Contractor shall submit to the Contracting Officer a certification that the operator has completed a training course approved by the nuclear density testing equipment manufacturer, the most recent data sheet from the manufacturer's calibration, and a copy of the most recent statistical check of the standard count precision.

b. The first test and every tenth test thereafter shall include a sand cone correlation test. The sand cone test shall be centered over the prepared surface for the nuclear test, shall include a nominal 6-inch diameter sand cone, and shall include a minimum wet soil weight of 6 pounds extracted from the hole. In addition, testing of aggregate base soils shall include a minimum of 3 sand cone correlations for each day of testing; and testing of bituminous shall include a minimum of 3 core densities for each day of testing. The density correlations shall be submitted with test results. Each transmittal including density test data shall include a summary of all density correlations for the job neatly prepared on a summary sheet including at a minimum:

- (1) Date, meter serial number and operators initials.
- (2) Standard count and adjustment data for each test.
- (3) Material type.
- (4) Probe depth.
- (5) Moisture content by each test method and the deviation.
- (6) Wet density by each test method and the deviation.

c. The nuclear density testing equipment shall be capable of extending a probe 6 inches minimum down into a hole. The probe shall generally be extended to the maximum depth obtainable.

d. Nuclear density testing equipment used within 2 vertical feet from the existing ground water level, 5 horizontal feet from a vertical wall or massive concrete structure, or in a trench shall have the standard count changed before and after each test, or the manufacturers published correction procedure shall be followed.

e. Nuclear density testing equipment shall not be used during rain.

3.16 SUBGRADE AND EMBANKMENT PROTECTION

Compacted subgrades that are disturbed by the Contractor's operations or adverse weather shall be scarified and compacted as specified herein to the required density prior to further construction thereon. Subgrades not meeting the specifications for finish, material type and density at the time of surface material placement shall be corrected at the Contractor's expense. Cohesive embankments and subgrades shall be kept crowned or sloped for drainage. Newly graded areas shall be protected from traffic and erosion. Any settlement or washing away that may occur from any cause shall be repaired. No base course or pavement shall be laid until the subgrade has been checked and approved by the Contracting Officer. Ditches and drains along subgrade shall be maintained to provide effective drainage. All work shall implement best management practices for erosion control.

-- End of Section --

DAILY REPORT FORM FOR EARTHWORK OBSERVATION

Project Name:	Date:
Contract Number: DACW37- - -	Temperature
QC Technician/Inspector:	Precipitation
Earthwork Contractor:	

Sunny <input type="checkbox"/>	partly cloudy <input type="checkbox"/>	overcast <input type="checkbox"/>	windy <input type="checkbox"/>	Other _____
--------------------------------	--	-----------------------------------	--------------------------------	-------------

Stripping and Excavation

Area (sta., Elevation)	Depth/Thickness Removed	Excavated Material (ASTM D 2488)	Base Material (ASTM D 2488)

Excavation Equipment:

Description	No. Operating	Type (Make & Model or Capacity)
Dozers		
Backhoes		
Wheel Loaders		
Other _____		

Fill Placement

Area (Sta., Elevation) (Grids, depth below FFE)	Fill Material (ASTM D 2488)	Lift Thickness & Number of Passes

Hauling/Placing Equipment:

Description	No. Operating	Type (Make & Model or Capacity)
Trucks		
Scrapers		
Compactors		
Dozers/Graders		
Other _____		

Density Tests Taken (list numbers): _____

Notes: _____

DAILY REPORT FORM FOR INSPECTION TRENCH		
Project Name:		Date:
Contract Number: DACW37- - -		Temperature
QC Technician/Inspector:		Precipitation
Earthwork Contractor:		
Sunny <input type="checkbox"/> partly cloudy <input type="checkbox"/> overcast <input type="checkbox"/> windy <input type="checkbox"/> Other _____		
Soil Stratigraphy		
Zone (label in sketch)	Soil Description (ASTM D 2488)	Water Conditions
Trench base soils		
Sketch of Trench Profile		
Beginning Sta.		Ending Sta.
Trench Width: _____ Side Slopes (vert., 1V:1H, etc.): _____ Pipes, tiles, or Conduits: _____ (indicate sta., depth or elevation, leakage, etc.) _____ Excavation Equipment:		
Description	No. Operating	Type (Make & Model or Capacity)
Backhoes		
Other _____		
Fill Material: _____ Borrow Area: _____ Compaction Equipment: _____ Lift Thickness: _____ Number of passes: _____ Density Tests Taken (list numbers): _____ Notes: _____ _____		

SECTION TABLE OF CONTENTS

DIVISION 02 - SITE WORK

SECTION 02315

EXCAVATION, FILLING AND BACKFILLING FOR STRUCTURES

04/01

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 DEGREE OF COMPACTION
- 1.3 SUBMITTALS

PART 2 PRODUCTS

- 2.1 MATERIALS
 - 2.1.1 Satisfactory Materials
 - 2.1.2 Granular Fill
 - 2.1.3 Unsatisfactory Materials

PART 3 EXECUTION

- 3.1 CLEARING AND GRUBBING
- 3.2 TOPSOIL
- 3.3 EXCAVATION
- 3.4 DRAINAGE AND DEWATERING
 - 3.4.1 Drainage
 - 3.4.2 Dewatering
- 3.5 SHORING
- 3.6 CLASSIFICATION OF EXCAVATION
- 3.7 BLASTING
- 3.8 EXCAVATED MATERIALS
- 3.9 FINAL GRADE OF SURFACES TO SUPPORT CONCRETE
- 3.10 SUBGRADE PREPARATION
- 3.11 FILLING AND BACKFILLING
- 3.12 TESTING
 - 3.12.1 In-Place Densities
 - 3.12.1.1 In-Place Density of Subgrades
 - 3.12.1.2 In-Place Density of Fills and Backfills
 - 3.12.2 Optimum Moisture and Laboratory Maximum Density
- 3.13 GRADING
- 3.14 TOPSOIL AND SEEDING
- 3.15 PROTECTION

-- End of Section Table of Contents --

SECTION 02315

EXCAVATION, FILLING AND BACKFILLING FOR STRUCTURES

04/01

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 698	(1991) Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/cu. ft. (600 kN-m/cu.m.))
ASTM D 1556	(1990; R 1996) Density and Unit Weight of Soil in Place by the Sand-Cone Method
ASTM D 2167	(1994) Density and Unit Weight of Soil in Place by the Rubber Balloon Method
ASTM D 2216	(1992) Laboratory Determination of Water (Moisture) Content of Soil, and Rock
ASTM D 2487	(1993) Classification of Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D 2922	(1996) Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
ASTM D 2937	(1994) Density of Soil in Place by the Drive-Cylinder Method
ASTM D 3017	(1988; R 1993) Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)
ASTM D 4318	(1995a) Liquid Limit, Plastic Limit, and Plasticity Index of Soils

1.2 DEGREE OF COMPACTION

Degree of compaction is expressed as a percentage of the maximum density obtained by the test procedure presented in ASTM D 698, abbreviated as

percent laboratory maximum density.

Line of protection includes levee, floodwall and closures.

1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with SECTION 01330: SUBMITTAL PROCEDURES:

SD-09 Reports

Testing; FIO.

Copies of all laboratory and field test reports within 24 hours of the completion of the test.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Satisfactory Materials

Satisfactory materials for general and structural backfill for structures located on the riverside of the levee and within the line of protection, pump stations, and storm sewer structures shall be comprised of native soils classified by ASTM D 2487 as SC, CL, CL-ML, and CH, unless otherwise shown.

2.1.2 Granular Fill

Granular material shall be satisfactory material containing not more than 12 percent by weight of material passing the No. 200 sieve. For free draining select granular fill, the material shall contain not more than 5 percent by weight of material passing the No. 200 sieve.

2.1.3 Unsatisfactory Materials

Materials which do not comply with the requirements for satisfactory materials are unsatisfactory. Unsatisfactory materials also include man-made fills, trash, refuse, or backfills from previous construction. Unsatisfactory material also includes material classified as satisfactory which contains root and other organic matter, frozen material, and stones larger than 3 inches. The Contracting Officer shall be notified if any contaminated materials are found.

PART 3 EXECUTION

3.1 CLEARING AND GRUBBING

Clearing and grubbing is specified in SECTION 02230: CLEARING AND GRUBBING.

3.2 TOPSOIL

Stripping topsoil is specified in SECTION 02300: EARTHWORK.

3.3 EXCAVATION

Excavation shall conform to the dimensions and elevations indicated for each structure, and footing except as specified. Excavation shall extend a sufficient distance from walls and footings to allow for placing and removal of forms. Excavations below indicated depths will not be permitted except to remove unsatisfactory material or to aid in dewatering. Unsatisfactory material encountered below the grades shown shall be removed as directed and replaced with satisfactory material; and payment will be made in conformance with the CHANGES clause of SECTION 00700: CONTRACT CLAUSES. Satisfactory material removed below the depths indicated, without specific direction of the Contracting Officer, shall be replaced, at no additional cost to the Government, with satisfactory materials to the indicated excavation grade. Satisfactory material shall be placed and compacted as specified in paragraph FILLING AND BACKFILLING. Determination of elevations and measurements of approved overdepth excavation of unsatisfactory material below grades indicated shall be done under the direction of the Contracting Officer.

Where wet or otherwise unstable soil incapable of properly supporting the structure, as determined by the Contracting Officer, is unexpectedly encountered in the bottom of a trench, such material shall be removed to the depth required and replaced to the proper grade with select granular fill, compacted as provided in paragraph BACKFILLING of this section. When removal of unstable material is due to the fault or neglect of the Contractor in the Contractor's performance of shoring and sheeting, water removal, or other specified requirements, such removal and replacement shall be performed at no additional cost to the Government.

3.4 DRAINAGE AND DEWATERING

3.4.1 Drainage

Surface water shall be directed away from structure excavation sites to prevent erosion and undermining of foundations. Diversion ditches, dikes and grading shall be provided and maintained as necessary during construction. Excavated slopes and backfill surfaces shall be protected to prevent erosion and sloughing. Excavation shall be performed so that the site, the area immediately surrounding the site, and the area affecting operations at the site shall be continually and effectively drained.

3.4.2 Dewatering

See SECTION 01000: GENERAL for dewatering requirements.

Groundwater flowing toward or into structure excavations shall be controlled to prevent sloughing of excavation slopes and walls, boils, uplift and heave in the excavation and to eliminate interference with orderly progress of construction. French drains, sumps, ditches or trenches will not be permitted within 3 feet of the foundation of any structure, except with specific written approval, and after specific

contractual provisions for restoration of the foundation area have been made. Control measures shall be taken by the time the excavation reaches the groundwater level in order to maintain the integrity of the in situ material. While the excavation is open, the groundwater level shall be maintained continuously, at least 2 feet below the working level. Shut off dewatering system at such a rate to prevent a quick upsurge of water that might weaken the subgrade.

Crushed rock or granular soils are not allowed beneath structure foundations, unless otherwise shown. Other methods to create a dry, stable subgrade on which to place reinforcement and concrete shall be used that will not create a permeable condition beneath the structure. Remove to the maximum extent possible, pervious materials incorporated into dewatering systems. Prior to placement of backfill the Contracting Officer will determine if materials used in dewatering are removed satisfactorily.

3.5 SHORING

See SECTION 01000: GENERAL for shoring requirements. Sheet piling as indicated along the existing flood wall at Pump Station K12 is designed to provide excavation support during construction of the Pump Station. Temporary shoring is required to protect the landward side of the existing floodwall at Pump Station K12.

3.6 CLASSIFICATION OF EXCAVATION

Excavation will be unclassified regardless of the nature of material encountered.

3.7 BLASTING

Blasting will not be permitted.

3.8 EXCAVATED MATERIALS

Satisfactory excavated material required for fill or backfill shall be placed in the proper section of the permanent work required under this section or shall be separately stockpiled if it cannot be readily placed. Satisfactory material in excess of that required for the permanent work and all unsatisfactory material shall be disposed of as specified in SECTION 02300: EARTHWORK.

3.9 FINAL GRADE OF SURFACES TO SUPPORT CONCRETE

Excavation to final grade shall not be made until just before reinforcement or concrete is to be placed. For pile foundations, the excavation shall be stopped at an elevation of from 6 to 12 inches above the bottom of the footing before driving piles. After pile driving has been completed, the remainder of the excavation shall be completed to the elevations shown. Approximately level surfaces shall be roughened, and sloped surfaces shall be cut as indicated into rough steps or benches to provide a satisfactory bond. Shales shall be protected from slaking and all surfaces shall be protected from erosion resulting from ponding or flow of water.

3.10 SUBGRADE PREPARATION

Unsatisfactory material in surfaces to receive fill or in excavated areas shall be removed and replaced with satisfactory materials as directed by the Contracting Officer. The surface shall be scarified to a depth of 6 inches before the fill is started. Sloped surfaces steeper than 1 vertical to 4 horizontal shall be plowed, stepped, benched, or broken up so that the fill material will bond with the existing material. When subgrades are less than the specified density, the ground surface shall be broken up to a minimum depth of 6 inches, pulverized, and compacted to the specified density. When the subgrade is part fill and part excavation or natural ground, the excavated or natural ground portion shall be scarified to a depth of 12 inches and compacted as specified for the adjacent fill. Material shall not be placed on surfaces that are muddy, frozen, or contain frost. Compaction shall be accomplished by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, or other approved equipment well suited to the soil being compacted. Material shall be moistened or aerated as necessary to provide the moisture content that will readily facilitate obtaining the specified compaction with the equipment used. Minimum subgrade density shall be as specified in paragraph FILLING AND BACKFILLING.

3.11 FILLING AND BACKFILLING

Satisfactory materials shall be used in bringing fills and backfills to the lines and grades indicated and for replacing unsatisfactory materials. Satisfactory materials shall be placed in horizontal layers not exceeding 8 inches in loose thickness, or 6 inches when hand-operated compactors are used. After placing, each layer shall be plowed, disked, or otherwise broken up, moistened or aerated as necessary, thoroughly mixed and compacted as specified. Backfilling shall not begin until construction below finish grade has been approved, forms removed, and the excavation cleaned of trash and debris. Backfill shall be brought to indicated finish grade. Backfill shall not be placed in wet or frozen areas. Heavy equipment for spreading and compacting backfill shall not be operated closer to foundation or walls than a distance equal to the height of backfill above the top of footing; the area remaining shall be compacted in layers not more than 4 inches in compacted thickness with power-driven hand tampers suitable for the material being compacted. Backfill shall not be placed against structure prior to the concrete attaining 70% of its design strength. As far as practicable, backfill shall be brought up evenly on each side of the structure and sloped to drain away from the wall. When there are separate structural and grading contracts, the Structural Contractor shall backfill box culverts and buried structures to an elevation of 2 feet above the top of the structure. The Grading Contractor shall complete the remaining backfill in conjunction with grading operations. Each layer of fill and backfill shall be compacted to not less than the percentage of Standard Proctor maximum density specified

below:

	Percent Laboratory Maximum Density	
	<u>Cohesive material</u>	<u>Cohesionless material</u>
Fill, embankment, and structure backfill	95	95
Under structures, structure subgrade, floor slabs, steps, paved areas, around footings, and subgrade	100	100
Under structures and paved areas, top 12 inches	100	100

Approved compacted subgrades that are disturbed by the Contractor's operations or adverse weather shall be scarified and compacted as specified herein before to the required density prior to further construction thereon. Recomposition over underground utilities shall be by hand tamping.

3.12 TESTING

Testing shall be the responsibility of the Contractor and shall be performed at no additional cost to the Government. Testing shall be performed in accordance with SECTION 01451: CONTRACTOR QUALITY CONTROL.

3.12.1 In-Place Densities

In-place density and moisture content test results shall be included with the Contractor's daily construction quality control reports.

3.12.1.1 In-Place Density of Subgrades

One test per 500 square feet per lift or fraction thereof as determined by the foundation area of each structure.

3.12.1.2 In-Place Density of Fills and Backfills

Not less than 1 test for each 2 vertical feet of fill per 100 linear feet or fraction thereof as determined by the perimeter or circumference of each structure.

3.12.2 Optimum Moisture and Laboratory Maximum Density

Tests shall be made for each type material or source of material, including borrow material to determine the optimum moisture and laboratory maximum density values. One representative test per source, or when any change in material occurs which may affect the optimum moisture content or laboratory maximum density will be made.

3.13 GRADING

Areas within 5 feet outside of each structure line shall be constructed true-to-grade, shaped to drain, and shall be maintained free of trash and debris until final inspection has been completed and the work has been accepted.

3.14 TOPSOIL AND SEEDING

Placement of topsoil and seeding is specified in SECTION 02920: SEEDING, SODDING, AND TOPSOIL.

3.15 PROTECTION

Settlement or washing that occurs in graded, topsoiled, or backfilled areas prior to acceptance of the work, shall be repaired and grades reestablished to the required elevations and slopes.

-- End of Section --

SECTION TABLE OF CONTENTS

DIVISION 02 - SITE WORK

SECTION 02316

EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITY SYSTEMS

04/01

PART 1 GENERAL

- 1.1 RELATED WORK OF OTHER SECTIONS
- 1.2 REFERENCES
- 1.3 DEFINITIONS

PART 2 PRODUCTS

- 2.1 MATERIALS
 - 2.1.1 Unyielding Material
 - 2.1.2 Unstable Material
 - 2.1.3 Granular Bedding and Drainage Fill
 - 2.1.4 Impervious Fill

PART 3 EXECUTION

- 3.1 EXCAVATION
 - 3.1.1 Trench Excavation
 - 3.1.1.1 Bottom Preparation
 - 3.1.1.2 Unyielding Material
 - 3.1.1.3 Unstable Material
 - 3.1.1.4 Excavation for Appurtenances
 - 3.1.2 Stockpiles
- 3.2 BACKFILLING AND COMPACTION
 - 3.2.1 Levees
 - 3.2.2 Bedding and Initial Backfill
 - 3.2.3 Final Backfill
 - 3.2.4 Backfill for Appurtenances
- 3.3 TESTING
 - 3.3.1 Testing Facilities
 - 3.3.2 Testing of Backfill Materials
 - 3.3.3 Field Density Tests

-- End of Section Table of Contents --

SECTION 02316

EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITY SYSTEMS

04/01

PART 1 GENERAL

1.1 RELATED WORK OF OTHER SECTIONS

Dewatering is covered in SECTION 01000: GENERAL. Material definitions, backfill compaction and testing requirements are covered in SECTION 02300: EARTHWORK, and SECTION 02630: STORM-DRAINAGE SYSTEM.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 698	(1991) Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/cu.ft.)
ASTM D 1556	(1990; R 1996) Density and Unit Weight of Soil in Place by the Sand-Cone Method
ASTM D 2487	(1993) Classification of Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D 2922	(1996) Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
ASTM D 3017	(1988; R 1993) Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)

Corps of Engineers (COE)

EM 385-1-1	Safety and Health Requirements Manual
------------	---------------------------------------

1.3 DEFINITIONS

Reference to pipes shall include culverts. Appurtenant structures include manholes, inlets, outlets, headwalls, or similar structures.

PART 2 PRODUCTS

2.1 MATERIALS

In addition to the definitions below, material definitions shall be as specified in SECTION 02300: EARTHWORK.

2.1.1 Unyielding Material

Unyielding material shall consist of rock and gravelly soils with stones greater than 3 inches in any dimension or as defined by the pipe manufacturer, whichever is smaller.

2.1.2 Unstable Material

Unstable material shall consist of materials too soft and/or compressible to properly support the pipe or appurtenant structure.

2.1.3 Granular Bedding and Drainage Fill

Material consisting of well-graded sand, gravel, crushed gravel, crushed stone or crushed slag composed of hard, tough and durable particles, and shall contain not more than 12 percent by weight of material passing a No. 200 mesh sieve and no less than 95 percent by weight passing the 3/4 inch sieve.

2.1.4 Impervious Fill

See SECTION 02300: EARTHWORK.

PART 3 EXECUTION

3.1 EXCAVATION

Trench excavation shall be by open cut except for 3 segments of storm sewer identified in SECTION 02630: STORM-DRAINAGE SYSTEM to be installed by jacking techniques. All excavation shall be constructed in accordance with the Safety and Health Requirements Manual (EM 385-1-1) and/or OSHA Standards. Allowable trench widths, depths, side slopes, sheet and bracing requirements, and other considerations are given in the OSHA Standard; and an abbreviated version is given in the Safety and Health Requirements Manual.

Provide full access to public/private premises and fire hydrants so as to prevent serious disruption of travel. Protect and maintain benchmarks and monuments during excavations.

3.1.1 Trench Excavation

Excavation shall be performed to the lines and grades indicated. Remove existing home foundations, walls, slabs, and other related materials to the extent necessary to install the utility system. During excavation, material satisfactory for backfilling shall be stockpiled in a neat and orderly manner at a sufficient distance from the banks of the trench to avoid overloading and to prevent slides or caving. Topsoil shall be stockpiled separately from suitable backfill material. Grading shall be done as may be necessary to prevent surface water from flowing into the

excavation, and any water accumulating therein shall be removed to maintain the stability of the bottom and sides of the excavation. Unauthorized over excavation shall be backfilled at no additional cost to the Government.

3.1.1.1 Bottom Preparation

The bottoms of trenches shall be accurately graded to provide uniform bearing and support for the bottom quadrant of each section of the pipe. Pipe shall rest on undisturbed or properly placed and compacted soil along its entire length. Bell holes shall be excavated to the necessary size at each joint or coupling to eliminate point bearing. Stones of 3 inches or greater in any dimension, or as recommended by the pipe manufacturer, whichever is smaller, shall be removed to avoid point bearing.

3.1.1.2 Unyielding Material

Where unyielding material is encountered in the bottom of the trench, such material shall be removed 8 inches below the required grade and replaced with granular bedding, except as provided below.

For levees and all utility systems passing through or beneath levees, the replaced fill shall meet the requirements for the zone where it is located. Use of material more pervious than surrounding soils is not acceptable.

3.1.1.3 Unstable Material

Where wet, soft, unsuitable or otherwise unstable soil incapable of properly supporting pipe is encountered in the bottom of a trench or excavation, the Contractor shall immediately contact the Contracting Officer prior to proceeding with the associated work. When removal of unstable material is required due to inadequate shoring and sheeting, water removal, control of ground water or other similar operations, such unstable material shall be excavated and replaced with satisfactory material as directed at no additional cost to the Government.

3.1.1.4 Excavation for Appurtenances

Excavation for appurtenances shall be of sufficient size to permit the placement and removal of forms for the full length and width of structure footings and foundations as shown. Removal of unstable material shall be as specified above. When concrete is to be placed in an excavated area, special care shall be taken not to disturb the bottom of the excavation. Excavation to the final grade level shall not be made until just before concrete is to be placed or appurtenances are to be installed.

3.1.2 Stockpiles

Stockpiles of satisfactory material shall be placed and graded as specified. Stockpiles shall be kept in a neat and well drained condition, giving due consideration to drainage at all times. The ground surface at stockpile locations shall be cleared, grubbed, and sealed. Excavated satisfactory and unsatisfactory materials shall be separately stockpiled. Stockpiles of satisfactory materials shall be protected from contamination

which may destroy the quality and fitness of the stockpiled material. If the Contractor fails to protect the stockpiles, and any material becomes unsatisfactory, such material shall be removed and replaced with satisfactory material from approved sources at no additional cost to the Government.

3.2 BACKFILLING AND COMPACTION

Backfilling shall not begin until construction below finish grade has been approved, storm drainage systems have been inspected, tested and approved; concrete forms have been removed and the excavation cleaned of frost, trash and debris. Backfill shall not be placed against foundation walls prior to 7 days after completion of the walls. As far as practicable, backfill shall be brought up evenly on each side of the wall. Trenches not immediately backfilled to grade shall be sloped to drain if practicable. Heavy equipment for spreading and compacting backfill shall not be operated closer to a foundation or other underground structural element than a distance equal to the height of backfill above the top of footing; the area remaining shall be compacted with power driven hand tampers suitable for the material being compacted.

See SECTION 02300: EARTHWORK.

3.2.1 Levees

Where pipes are located within the right of way of levees, all fill materials shall meet the type and classification for the fill zone shown on drawings, otherwise use same type of material for the zone where the trench is located. The portion of the trench in native soils shall be backfilled with the excavated material that matches the surrounding soils.

3.2.2 Bedding and Initial Backfill

Bedding shall be of the type and thickness shown. Initial backfill material shall be placed and compacted to 95% of Standard Proctor density with manual tampers to a height above the pipe necessary to prevent damage, but not less than one foot. The backfill shall be brought up evenly on both sides of the pipe for the full length of the pipe. Care shall be taken to ensure thorough compaction of the fill under the haunches of the pipe.

3.2.3 Final Backfill

Final backfill is all material necessary to complete backfilling at the trench above the bedding and initial backfill. Final backfill shall consist of native impervious fill, unless otherwise required beneath pavements, adjacent to structures or other project features. Placement and compaction of final backfill shall comply with the requirements listed in SECTION 02300 : EARTHWORK for the fill zone or feature in which the utility trench is located.

3.2.4 Backfill for Appurtenances

After the structure has been constructed and the concrete has been allowed

to cure for 7 days, backfill shall be placed in such a manner that the structure will not be damaged by the shock of falling earth. The backfill material shall be deposited and compacted as specified for final backfill, and shall be brought up evenly on all sides of the structure to prevent eccentric loading and excessive stress.

3.3 TESTING

testing shall be the responsibility of the Contractor and shall be performed at no additional cost to the Government.

3.3.1 Testing Facilities

Tests shall be performed by an approved commercial testing laboratory or may be tested by facilities furnished by the Contractor. No work requiring testing will be permitted until the facilities have been inspected and approved by the Contracting Officer.

3.3.2 Testing of Backfill Materials

Classification of backfill materials shall be determined in accordance with ASTM D 2487 and the moisture-density relations of soils shall be determined in accordance with ASTM D 698. A minimum of one soil classification and one moisture-density relation test shall be performed on each different type of material used for bedding and backfill.

3.3.3 Field Density Tests

Tests shall be performed in sufficient numbers to ensure that the specified density is being obtained. A minimum of one field density test for each 2 vertical feet of backfill for every 300 feet of installation shall be performed. One moisture density relationship shall be determined for every 1500 cubic yards of material used. Field in-place density shall be determined in accordance with ASTM D 1556 and ASTM D 2922. When ASTM D 2922 is used, the calibration curves shall be checked and adjusted using the sand cone method as described in paragraph "Calibration" of the ASTM publication. ASTM D 2922 results in a wet unit weight of soil and when using this method, ASTM D 3017 shall be used to determine the moisture content of the soils. The calibration curves furnished with the gauges shall be checked along with density calibration checks as described in ASTM D 3017. The calibration checks of both the density and moisture gauges shall be made at the beginning of a job, on each different type of material encountered, at intervals as directed by the Contracting Officer. Copies of calibration curves, results of calibration tests, and field and laboratory density tests shall be furnished to the Contracting Officer. Trenches improperly compacted shall be reopened to the depth directed, then refilled and compacted to the density specified at no additional cost to the Government.

-- End of Section --

SECTION TABLE OF CONTENTS

DIVISION 02 - SITE WORK

SECTION 02373

SEPARATION GEOTEXTILE

04/01

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 SUBMITTALS
- 1.3 DELIVERY, STORAGE AND HANDLING
 - 1.3.1 Delivery
 - 1.3.2 Storage
 - 1.3.3 Handling

PART 2 PRODUCTS

- 2.1 RAW MATERIALS
 - 2.1.1 Geotextile
 - 2.1.2 Thread

PART 3 EXECUTION

- 3.1 INSTALLATION
 - 3.1.1 Subgrade Preparation
 - 3.1.2 Placement
- 3.2 SEAMS
 - 3.2.1 Overlap Seams
 - 3.2.2 Sewn Seams
- 3.3 PROTECTION
- 3.4 REPAIRS
- 3.5 PENETRATIONS
- 3.6 COVERING

-- End of Section Table of Contents --

SECTION 02373

SEPARATION GEOTEXTILE

04/01

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of the specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 3786	(1987) Hydraulic Bursting Strength of Knitted Goods and Nonwoven Fabrics: Diaphragm Bursting Strength Tester Method
ASTM D 4354	(1996) Sampling of Geosynthetics for Testing
ASTM D 4355	(1992) Deterioration of Geotextiles from Exposure to Ultraviolet Light and Water (Xenon-Arc Type Apparatus)
ASTM D 4491	(1995) Water Permeability of Geotextiles by Permittivity
ASTM D 4533	(1991) Trapezoid Tearing Strength of Geotextiles
ASTM D 4632	(1991) Grab Breaking Load and Elongation of Geotextiles
ASTM D 4751	(1995) Determining Apparent Opening Size of a Geotextile
ASTM D 4759	(1988; R 1996) Determining the Specification Conformance of Geosynthetics
ASTM D 4833	(1988; R 1996) Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products
ASTM D 4873	(1995) Identification, Storage, and Handling of Geosynthetic Rolls

1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having a "FIO" designation are for information only. The

following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-06 Instructions

Manufacturing Quality Control Sampling and Testing; FIO.

A minimum of 14 days prior to scheduled use, manufacturer's quality control manual including instructions for geotextile storage, handling, installation, seaming, and repair.

SD-13 Certificates

Geotextile; GA

A minimum of 14 days prior to scheduled use, manufacturer's certificate of compliance stating that the geotextile meets the requirements of this section. This submittal shall include copies of manufacturer's quality control test results. For needle punched geotextiles, the manufacturer shall also certify that the geotextile has been continuously inspected using permanent on-line full-width metal detectors and does not contain any needles which could damage other geosynthetic layers. The certificate of compliance shall be attested to by a person having legal authority to bind the geotextile manufacturer.

1.3 DELIVERY, STORAGE AND HANDLING

Delivery, storage, and handling of geotextile shall be in accordance with ASTM D 4873.

1.3.1 Delivery

The Contracting Officer will be present during delivery and unloading of the geotextile. Rolls shall be packaged in an opaque, waterproof, protective plastic wrapping. The plastic wrapping shall not be removed until deployment. If quality assurance samples are collected, rolls shall be immediately rewrapped with the plastic wrapping. Geotextile or plastic wrapping damaged during storage or handling shall be repaired or replaced, as directed. Each roll shall be labeled with the manufacturer's name, geotextile type, roll number, roll dimensions (length, width, gross weight), and date manufactured.

1.3.2 Storage

Geotextile rolls shall be protected from becoming saturated. Rolls shall either be elevated off the ground or placed on a sacrificial sheet of plastic. The geotextile rolls shall also be protected from the following: construction equipment, ultraviolet radiation, chemicals, sparks and flames, temperatures in excess of 160 degrees F, and any other environmental condition that may damage the physical properties of the geotextile.

1.3.3 Handling

Geotextile rolls shall be handled and unloaded with load carrying straps, a fork lift with a stinger bar, or an axial bar assembly. Rolls shall not be dragged along the ground, lifted by one end, or dropped to the ground.

PART 2 PRODUCTS

2.1 RAW MATERIALS

2.1.1 Geotextile

Geotextile shall be a woven pervious sheet of polymeric material and shall consist of long-chain synthetic polymers composed of at least 95 percent by weight polyolefins, polyesters, or polyamides. The use of woven slit film geotextiles (i.e. geotextiles made from yarns of a flat, tape-like character) will not be allowed. Stabilizers and/or inhibitors shall be added to the base polymer, as needed, to make the filaments resistant to deterioration by ultraviolet light, oxidation, and heat exposure. Regrind material, which consists of edge trimmings and other scraps that have never reached the consumer, may be used to produce the geotextile. Post-consumer recycled material shall not be used. Geotextile shall be formed into a network such that the filaments or yarns retain dimensional stability relative to each other, including the selvages. Geotextiles and factory seams shall meet the requirements specified in Table 1. Where applicable, Table 1 property values represent minimum average roll values (MARV) in the weakest principal direction. Values for AOS represent maximum average roll values.

TABLE 1. GEOTEXTILE PHYSICAL PROPERTIES

PROPERTY	TEST METHOD	TEST VALUE
Elongation percent	Less Than 15	ASTM D 4632
Apparent Opening Size (U.S. Sieve)	70	ASTM D 4751
Permittivity, sec-1	0.1	ASTM D 4491
Puncture, lbs.	90	ASTM D 4833
Grab Tensile, lbs.	250	ASTM D 4632
Trapezoidal Tear, lbs.	90	ASTM D 4533
Burst Strength, psi	350	ASTM D 3786
Ultraviolet Stability (percent strength retained at 500 hours)	50	ASTM D 4355

2.1.2 Thread

Sewn seams shall be constructed with high-strength polyester, nylon, or other approved thread type. Thread shall have ultraviolet light stability equivalent to the geotextile and the color shall contrast with the geotextile.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Subgrade Preparation

The surface underlying the geotextile shall be smooth and free of ruts or protrusions which could damage the geotextile. Subgrade materials and compaction requirements shall be in accordance with Section 02722: AGGREGATE BASE OR SURFACE COURSE.

3.1.2 Placement

The Contractor shall request the presence of the Contracting Officer during handling and installation. Geotextile rolls which are damaged or contain imperfections shall be repaired or replaced as directed. The geotextile shall be laid flat and smooth so that it is in direct contact with the subgrade. The geotextile shall also be free of tensile stresses, folds, and wrinkles. On slopes greater than 5 horizontal on 1 vertical, the geotextile shall be laid with the machine direction of the fabric parallel to the slope direction.

3.2 SEAMS

3.2.1 Overlap Seams

Overlapping is not permitted. Sewn seams shall be used to connect all geotextile panels.

3.2.2 Sewn Seams

Seams shall be continuously sewn using a J-type seam with two rows of a 401 locking chain stitch. The minimum distance from the geotextile edge to the stitch line nearest to that edge shall be 3 inches unless otherwise recommended by the manufacturer. The thread at the end of each seam run shall be tied off to prevent unraveling. Seams shall be on the top side of the geotextile to allow inspection.

3.3 PROTECTION

The geotextile shall be protected during installation from clogging, tears, and other damage. Damaged geotextile shall be repaired or replaced as directed. Adequate ballast (e.g. sand bags) shall be used to prevent uplift by wind. The geotextile shall not be left uncovered for more than 2 days during installation.

3.4 REPAIRS

Geotextile damaged during installation shall be repaired by placing a patch of the same type of geotextile which extends a minimum of 12 inches beyond the edge of the damage or defect. Patches shall be continuously fastened using a sewn seam or other approved method. The machine direction of the patch shall be aligned with the machine direction of the geotextile being repaired. Geotextile which cannot be repaired shall be replaced.

3.5 PENETRATIONS

Engineered penetrations of the geotextile shall be constructed as shown on the drawings.

3.6 COVERING

Geotextile shall not be covered prior to approval by the Contracting Officer. The Contractor shall request the presence of the Contracting Officer during covering of the geotextile. Cover soil shall be placed in a manner that prevents wrinkles from folding over onto themselves. No equipment shall be operated directly on top of the geotextile. A minimum of 12 inches of soil shall be maintained between full-scale construction equipment tires/tracks and the geotextile during the covering process.

-- End of Section --

SECTION TABLE OF CONTENTS

DIVISION 02 - SITE WORK

SECTION 02378

GEOTEXTILE FILTERS

04/01

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 SUBMITTALS
- 1.3 SHIPMENT, HANDLING, AND STORAGE
 - 1.3.1 Shipment and Storage

PART 2 PRODUCTS

- 2.1 MATERIALS
 - 2.1.1 Geotextile
 - 2.1.1.1 General
 - 2.1.1.2 Geotextile Fiber
 - 2.1.2 Seams
 - 2.1.3 Securing Pins

PART 3 EXECUTION

- 3.1 SURFACE PREPARATION
- 3.2 INSTALLATION OF THE GEOTEXTILE
 - 3.2.1 General
 - 3.2.2 Placement
- 3.3 PROTECTION
- 3.4 OVERLAPPING AND SEAMING
 - 3.4.1 Overlapping
 - 3.4.2 Sewn Seams

-- End of Section Table of Contents --

SECTION 02378

GEOTEXTILE FILTERS

04/01

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 123	(1996a) Standard Terminology Relating to Textiles
ASTM D 4354	(1996) Sampling of Geosynthetics for Testing
ASTM D 4355	(1992) Deterioration of Geotextiles from Exposure to Ultraviolet Light and Water (Xenon-Arc Type Apparatus)
ASTM D 4491	(1999) Water Permeability of Geotextiles By Permittivity
ASTM D 4533	(1991; R 1996) Trapezoid Tearing Strength of Geotextiles
ASTM D 4632	(1991; R 1996) Grab Breaking Load and Elongation of Geotextiles
ASTM D 4751	(1999) Determining Apparent Opening Size of a Geotextile
ASTM D 4833	(1988; R 1996) Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products
ASTM D 4873	(1997) Identification, Storage, and Handling of Geosynthetic Rolls
ASTM D 4884	(1996) Strength of Sewn or Thermally Bonded Seams of Geotextiles

U.S. ARMY CORPS OF ENGINEERS, ENGINEERING MANUALS (EM)

EM 1110-2-1601	(1991; Change 1-1994) Hydraulic Design of Flood Control Channels
----------------	--

1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-13 Certificates

Geotextile; GA

Submit the manufacturer's certification of the geotextile material. All brands of geotextile and all seams to be used will be accepted on the basis of mill certificates or affidavits. Submit duplicate copies of the mill certificate or affidavit signed by a legally authorized official from the company manufacturing the geotextile. The mill certificate or affidavit shall attest that the geotextile meets the chemical, physical and manufacturing requirements stated in this specification.

SD-14 Samples

1.3 SHIPMENT, HANDLING, AND STORAGE

1.3.1 Shipment and Storage

Only approved geotextile rolls shall be delivered to the project site. All geotextile shall be labeled, shipped, stored, and handled in accordance with ASTM D 4873. No hooks, tongs, or other sharp instruments shall be used for handling geotextile.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Geotextile

2.1.1.1 General

The geotextile shall be a non-woven pervious sheet of plastic yarn as defined by ASTM D 123. The geotextile shall equal or exceed the minimum average roll values listed in TABLE 1, MINIMUM PHYSICAL REQUIREMENTS FOR DRAINAGE GEOTEXTILE. Strength values indicated in the table are for the weaker principal direction.

TABLE 1
MINIMUM PHYSICAL REQUIREMENTS FOR FILTERS GEOTEXTILE

PROPERTY	UNITS	ACCEPTABLE VALUES	TEST METHOD
GRAB STRENGTH	lb	180	ASTM D 4632
SEAM STRENGTH	lb	180	ASTM D 4632

TABLE 1
MINIMUM PHYSICAL REQUIREMENTS FOR FILTERS GEOTEXTILE

PUNCTURE	lb	80	ASTM D 4833
TRAPEZOID TEAR	lb	50	ASTM D 4533
APPARENT OPENING SIZE	U.S. SIEVE	100	ASTM D 4751
PERMITTIVITY	sec -1	0.1	ASTM D 4491

2.1.1.2 Geotextile Fiber

Fibers used in the manufacturing of the geotextile shall consist of a long-chain synthetic polymer composed of at least 85 percent by weight of polyolefins, polyesters, or polyamides. Stabilizers and/or inhibitors shall be added to the base polymer if necessary to make the filaments resistant to deterioration caused by ultraviolet light and heat exposure. Reclaimed or recycled fibers or polymer shall not be added to the formulation. Geotextile shall be formed into a network such that the filaments or yarns retain dimensional stability relative to each other, including the edges. The edges of the geotextile shall be finished to prevent the outer fiber from pulling away from the geotextile.

2.1.2 Seams

The seams of the geotextile shall be sewn with thread of a material meeting the chemical requirements given above for geotextile yarn or shall be bonded by cementing or by heat. The sheets of geotextile shall be attached at the factory or another approved location, if necessary, to form sections not less than 12 feet wide. Seams shall be tested in accordance with method ASTM D 4884. The strength of the seam shall be not less than the required grab tensile strength of the unaged geotextile in any principal direction.

2.1.3 Securing Pins

The geotextile shall be secured to the embankment or foundation soil to prevent movement prior to placement of revetment materials. Appropriate means to prevent movement such as pins, staples, sand bags, and stone shall be used. When used securing pins and staples, the pins or staples shall be inserted through the geotextile along the line passing through the midpoint of the seam locations. Securing pins and staples shall be removed as placement of revetment materials are placed to prevent tearing of geotextile or enlarging holes.

Spacing between securing geotextile depends on the steepness of the embankment slope. The maximum spacing shall be equal to or less than the values listed in TABLE 2, MAXIMUM SPACING FOR SECURING GEOTEXTILE. When windy conditions prevail at the construction site, the spacing should be decreased upon the demand of the Contracting Officer. Terminal ends of the geotextile shall be anchored with key trench or apron at crest, toe of the slope and upstream and downstream limits of installation.

TABLE 2
MAXIMUM SPACING FOR SECURING GEOTEXTILE

EMBANKMENT	SPACING, feet
STEEPER THAN 1V ON 3H	2
1V ON 3H TO 1V ON 4H	3
FLATTER THAN 1V ON 4H	5

PART 3 EXECUTION

3.1 SURFACE PREPARATION

Surface on which the geotextile will be placed shall be prepared to a relatively smooth surface condition, in accordance with the applicable portion of this specification and shall be free from obstruction, debris, depressions, erosion feature, or vegetation. Any irregularities will be removed so as to insure continuous, intimate contact of the geotextile with all the surface. Any loose material, soft or low density pockets of material, will be removed; erosion features such as rills, gullies etc. must be graded out of the surface before geotextile placement.

3.2 INSTALLATION OF THE GEOTEXTILE

3.2.1 General

The geotextile shall be placed in the manner and at the locations shown. At the time of installation, the geotextile shall be rejected if it has defects, rips, holes, flaws, deterioration or damage incurred during manufacture, transportation or storage.

3.2.2 Placement

The geotextile shall be placed smooth and free of tension, stress, folds, wrinkles, or creases. Temporarily secure the geotextile to help hold it in place until the bedding layer is placed shall be allowed. The temporary securing measures shall be removed as the bedding is placed to relieve high tensile stress which may occur during placement of material on the geotextile. Trimming shall be performed in such a manner that the geotextile shall not be damaged in any way.

3.3 PROTECTION

The geotextile shall be protected at all times during construction from contamination by surface runoff and any geotextile so contaminated shall be removed and replaced with uncontaminated geotextile. Any damage to the geotextile during its installation or during placement of bedding materials shall be replaced by the Contractor at no cost to the Government and the work shall be scheduled so that the covering of the geotextile with a layer

of the specified material is accomplished within 2 calendar days after placement of the geotextile. Failure to comply shall require replacement of geotextile. The geotextile shall be protected from damage prior to and during the placement of riprap or other materials. Before placement of riprap or other materials, the Contractor shall demonstrate that the placement technique will not cause damage to the geotextile. In no case shall any type of equipment be allowed on the unprotected geotextile.

3.4 OVERLAPPING AND SEAMING

3.4.1 Overlapping

The overlapping of geotextile is not allowed. Seaming will be required.

3.4.2 Sewn Seams

Seam geotextile panels together with a J-type seam using two rows of 401 locking chain stitches.

High strength thread should be used such that seam test should conform to ASTM D 4884. The thread shall meet the chemical, ultraviolet, and physical requirements of the geotextile, and the color shall be different from that of the geotextile. The seam strength shall be equal to the strength required for the geotextile in the direction across the seam.

-- End of Section --

SECTION TABLE OF CONTENTS

DIVISION 02 - SITE WORK

SECTION 02388

STONE PROTECTION (RIPRAP)

04/01

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 SUBMITTALS

PART 2 PRODUCTS

- 2.1 STONE SOURCES AND EVALUATION
 - 2.1.1 Alternate Sources
 - 2.1.2 Acceptance of Materials
- 2.2 RIPRAP
 - 2.2.1 General
 - 2.2.2 Production
- 2.3 RIPRAP BEDDING
 - 2.3.1 General
 - 2.3.2 Production
- 2.4 GEOTEXTILE
- 2.5 SOURCE QUALITY CONTROL
 - 2.5.1 Sampling Requirements
 - 2.5.2 Gradation Testing
 - 2.5.2.1 Riprap
 - 2.5.2.2 Riprap Test Method A
 - 2.5.2.3 Riprap Test Method B
 - 2.5.2.4 Riprap Bedding
 - 2.5.2.5 Gradation Tests for Riprap Bedding
- 2.6 STOCKPILES

PART 3 EXECUTION

- 3.1 CONSTRUCTION TOLERANCES
 - 3.1.1 Subgrades
 - 3.1.2 Layer Thickness
 - 3.1.3 Surface Tolerances
- 3.2 FOUNDATION PREPARATION
- 3.3 PLACEMENT OF RIPRAP
 - 3.3.1 Layer Requirements
 - 3.3.2 Construction Methods
 - 3.3.3 Riprap Placement on Geotextile
- 3.4 MAINTENANCE
- 3.5 CONTRACTOR QUALITY CONTROL

-- End of Section Table of Contents --

SECTION 02388

STONE PROTECTION (RIPRAP)

04/01

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 4992 (1994) Evaluation of Rock to be Used for Erosion Control

U.S. ARMY CORPS OF ENGINEERS, ENGINEERING MANUALS (EM)

EM 1110-2-1601 (1991) Hydraulic Design of Flood Control Channels

EM 1110-2-1906 (Nov. 1970) Laboratory Soils Testing with Change 1 (May, 1980) and Change 2 (Aug. 1986).

EM 1110-2-2302 (1990) Construction with Large Stone

NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY (NIST)

NIST HB 44 (1997) NIST Handbook 44: Specifications, Tolerances, and Other Technical Requirements for Weighing and Measuring Devices

1.2 SUBMITTALS

Government approval is required for all submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-08 Statements

Material Sources; GA.

The Contractor shall designate in writing only one source or one combination of sources from which he proposes to furnish stone. The Contractor shall state in writing methods of processing and handling riprap, and shall notify the Contracting Officer when production methods

are changed.

SD-09 Reports

Gradation Test; FIO.

Gradation Test Results for riprap and aggregates. Riprap gradation and riprap bedding testing results shall be submitted on the WORKSHEET FOR GRADATION ANALYSIS OF RIPRAP (Form 4055) and GRADATION CURVES FOR RIPRAP FILTER AND BEDDING (Form 4056). A blank copy of each form is included at the end of this section.

SD-13 Certificates

Certified Weight Scale Tickets; FIO.

Copies of all certified weight scale tickets shall be furnished to the Contracting Officer at a frequency as directed. The tickets do not need to be formally submitted through the submittal process.

PART 2 PRODUCTS

2.1 STONE SOURCES AND EVALUATION

Stone and aggregate materials may be quarried rock or durable fieldstone and shall be produced or obtained from the sources listed in SECTION 00830: ATTACHMENTS. If the Contractor proposes to furnish materials from a source not listed, the Government Geologist will make such investigations and evaluations as necessary to determine whether or not materials with acceptable durability can be produced from the proposed source. The rock supplied shall be composed of a quality fieldstone or be quarried from one rock formation to provide a product of uniform appearance. The Contractor shall not supply rock from various formations, or mix field stone with quarried rock, unless approved by the Contracting Officer. It is the Contractor's responsibility to determine that the stone source or combination of sources selected is capable of providing the quality, quantities and gradation needed and at the rate needed to maintain the scheduled progress of the work.

2.1.1 Alternate Sources

If the Contractor proposes to furnish stone materials from a source not listed in SECTION 00830: ATTACHMENTS, the Government Geologist will make such investigations and evaluations as necessary to determine whether or not materials meeting the requirements specified can be produced from the proposed source. Alternate sources from which the Contractor proposes to obtain stone materials shall be selected and submitted for approval at least 30 days in advance of the time when the material will be required.

2.1.2 Acceptance of Materials

Acceptance of a source of stone is not to be construed as acceptance of all material from that source. The right is reserved to reject materials from certain localized areas, zones, strata, or channels, when such materials

are unsuitable for stone as determined by the Contracting Officer. The Contracting Officer also reserves the right to reject individual units of produced specified materials in stockpiles at the quarry, all transfer points, and at the project construction site when such materials are determined to be unsuitable.

2.2 RIPRAP

Riprap gradation shall meet the requirements for R80 and R270 riprap indicated on the attached FORM 4055. The stone shall be well graded within the limits specified.

2.2.1 General

All stone shall be durable material. Stone for riprap shall have a specific gravity between 2.55 and 2.75 unless approved by the Contracting Officer. Stone shall be of a suitable quality to ensure permanence in the structure and in the climate in which it is to be used. It shall be free from cracks, blast fractures, bedding, seams and other defects that would tend to increase its deterioration from natural causes. The stone shall be clean and reasonably free from soil, quarry fines, and shall contain no refuse. Any foreign material adhering to or combined with the stone as a result of stockpiling shall be removed prior to placement. Neither the breadth nor the thickness of any piece of stone shall be less than one-third of its length. Occasional pieces of stone slightly larger than the maximum weight will be permitted provided the gradation and voids are not unduly affected and that surface tolerances are met.

2.2.2 Production

Riprap shall be handled and selectively loaded onto trucks in a manner to avoid segregation and provide a distribution of stone sizes consistent with the gradation band and test samples. Each truckload shall be representative of the gradation requirements.

2.3 RIPRAP BEDDING

Riprap bedding gradation shall meet the requirements listed in Table 1.

Table 1

Riprap Bedding

Sieve Size	Percent Finer By Weight
9"	100
6"	80 to 100
3"	55 to 85
1"	35 to 55
No. 4	10 to 35
No.10	0 to 25
No.40	0 to 10
No.200	0 to 5

2.3.1 General

All stone shall be durable material. Stone for riprap shall have a specific gravity between 2.55 and 2.75 unless approved by the Contracting Officer. Stone shall be of a suitable quality to ensure permanence in the structure and in the climate in which it is to be used. It shall be free from cracks, blast fractures, bedding, seams and other defects that would tend to increase its deterioration from natural causes. The stone shall be clean and reasonably free from soil, quarry fines, and shall contain no refuse.

2.3.2 Production

Riprap bedding shall be handled and selectively loaded onto trucks in a manner to avoid segregation and provide a distribution of stone sizes consistent with the gradation band and test samples. Each truckload shall be representative of the gradation requirements.

2.4 GEOTEXTILE

Geotextile shall meet the requirements of Section 02378 Geotextile Filter.

2.5 SOURCE QUALITY CONTROL

Sampling and testing shall be performed by and at the expense of the Contractor at no additional cost to the Government. Gradation tests shall be performed by either Method A or B at the frequency listed below. A satisfactory gradation test shall be obtained prior to any hauling and delivery of materials. All tests, including failing tests shall be submitted. Tests performed on material which do not meet gradation and shape requirements will not be counted as part of the tests required. The Contracting Officer shall be informed immediately of test results and draft copies of test results shall be furnished at the Contracting Officers request.

2.5.1 Sampling Requirements

The Contracting Officer shall direct the time and location of sampling, unless waived. Samples shall be taken from stockpiles or loaded trucks, and not directly from conveyers or chutes.

2.5.2 Gradation Testing

Perform gradation tests on riprap and riprap bedding as required below.

2.5.2.1 Riprap

a. Notification. The Contracting Officer shall be informed 24 hours before each riprap test.

b. Testing frequency. At least 1 gradation test shall be performed per source prior to delivery to the project site. Perform 1 test of riprap stockpiled or delivered to the project site.

c. Sample Size. The sample shall have a minimum gross weight not less than 25 times the maximum stone size in the specified gradation (25 * W

100).

2.5.2.2 Riprap Test Method A

Test method A shall consist of weighing all stones larger than 5 pounds in a sample. Five to seven weight classes shall be selected within the range of stone sizes. Each stone shall be weighed and recorded on the work sheet for method A. The weight of stones shall be summed for each weight class; after which calculations and a plot of the gradation shall be completed in accordance with accepted practice for soil and aggregate gradations.

2.5.2.3 Riprap Test Method B

Test method B shall consist of separating the stones into 5 to 7 piles, ordered by size. The sample shall be separated on a clean, hard surface that is free of smaller stones that could become mixed with the sample. The stones shall be visually screened to place them into appropriate piles.

All stones shall be separated and placed into a pile before weighing. After separating, the smallest and largest rock in each pile shall be weighed and recorded. The stones shall be adjusted as necessary so that the weight classes do not overlap. After adjustment is adequate and weight classes have been established, each pile of stone shall be weighed and recorded on the work sheet for method B. Calculations and a plot of the gradation shall be completed in accordance with accepted practice for soil and aggregate gradations.

2.5.2.4 Riprap Bedding

- a. Notification. The Contracting Officer shall be informed 24 hours before each riprap test.
- b. Testing frequency. At least 1 gradation test shall be performed per source prior to delivery to the project site. Perform 1 test of riprap stockpiled or delivered to the project site.
- c. Sample size. The sample shall have a minimum gross weight of 150 pounds.

2.5.2.5 Gradation Tests for Riprap Bedding

The sampling and testing procedures for gradation tests for bedding shall be in accordance with EM 1110-2-1906. Report results on ENG FORM 4056, GRADATION CURVES, provided at the end of this section.

2.6 STOCKPILES

Stockpiles shall be formed by a series of layers or truckload dumps, where the rock essentially remains where it is placed. Subsequent layers shall be started 10 feet from the edge of the previous layer so that the rock will not roll down the edges of the pile. Any stone which has become contaminated with soil or refuse shall not be put into the work unless the contaminating material has been removed prior to placement.

PART 3 EXECUTION

3.1 CONSTRUCTION TOLERANCES

Work shall generally meet the required elevations, slope and grade; and the outer surfaces shall be even and present a neat appearance.

3.1.1 Subgrades

Areas on which stone protection will be placed shall be graded and/or dressed to conform to cross sections shown on the contract drawings within 2 inches above or below the neat lines. The surface shall be reasonably smooth to match tolerances normally obtained by rough grading with bladed equipment. For subaqueous construction in greater than 3 feet of water, the tolerance shall be 6 inches.

3.1.2 Layer Thickness

Any layers found to be less than 80% of the specified thickness shall be corrected. This tolerance shall only be exceeded on isolated spot checks, and if the tolerance is commonly exceeded, the Contractor shall change his construction methods to improve the quality control. If it is necessary to estimate riprap quantities for changes, the volume shall be based on neat line dimensions and the plan dimension for thickness. A conversion factor of 1.5 tons/CY shall be used to determine quantity requirements, unless otherwise directed by the Contracting Officer.

3.1.3 Surface Tolerances

The finished surface tolerance above the neat line shall generally not deviate from the lines and grades shown by more than half (1/2) the average stone dimension of the gradation range. Riprap that has a rough and uneven surface shall be reworked by hand to stabilize stones that wobble and are out of tolerance, except where the Contracting Officer approves use of equipment. Rearranging of individual stones shall be required to the extent necessary to obtain a well-graded distribution of stone sizes.

3.2 FOUNDATION PREPARATION

Foundation areas shall be excavated or filled to the lines and grades shown. Filling shall be with earth similar to the adjacent material and shall be well compacted. Immediately prior to placing riprap, the prepared subgrade will be inspected by the Contracting Officer unless waived; and no material shall be placed thereon until that area has been approved.

3.3 PLACEMENT OF RIPRAP

3.3.1 Layer Requirements

Riprap shall be placed in a manner which will produce a well-graded mass of rock with the minimum practicable percentage of voids. The large stones shall be well distributed. The finished riprap shall be free from objectionable pockets of small stones and clusters of larger stones.

3.3.2 Construction Methods

Unsegregated stone shall be placed in a systematic manner. Riprap shall be placed to its full course thickness in one operation and in such manner as to avoid displacing underlying material. Placement shall typically begin at the bottom of the area to be covered and continue up slope. Subsequent loads of material shall be placed against previously placed material in such a manner as to ensure a relatively homogenous mass. Final finish of slope shall be performed as the material is placed.

Placing riprap in layers will not be permitted. Placing riprap by dumping it into chutes, or by any method likely to cause segregation of the various sizes, shall not be permitted. Placing riprap by dumping it at the top of the slope and pushing it down the slope shall not be permitted. No equipment shall be operated directly on the completed stone protection system. Dump trucks shall be equipped with bottom hinged tailgates if rock is directly placed into position with the trucks.

3.3.3 Riprap Placement on Geotextile

Riprap shall be placed over the geotextile by methods that do not tear, puncture, or reposition the fabric. Equipment shall be operated so as to minimize the drop height of the stone without contacting and damaging the geotextile. Generally this will be about 1 foot of drop from the bucket to the placement surface. Riprap shall be placed so that stones do not roll downhill.

3.4 MAINTENANCE

The Contractor shall maintain the stone protection and underlying works until accepted by the Contracting Officer. When appropriate, the Contractor shall place stone protection in a timely manner to reduce risk of scour. Any material displaced prior to acceptance and due to the Contractor's negligence or neglect shall be replaced at the Contractor's expense.

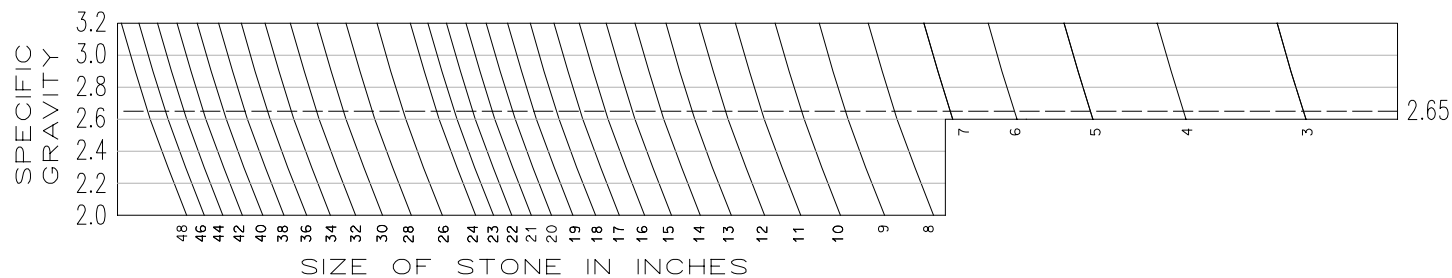
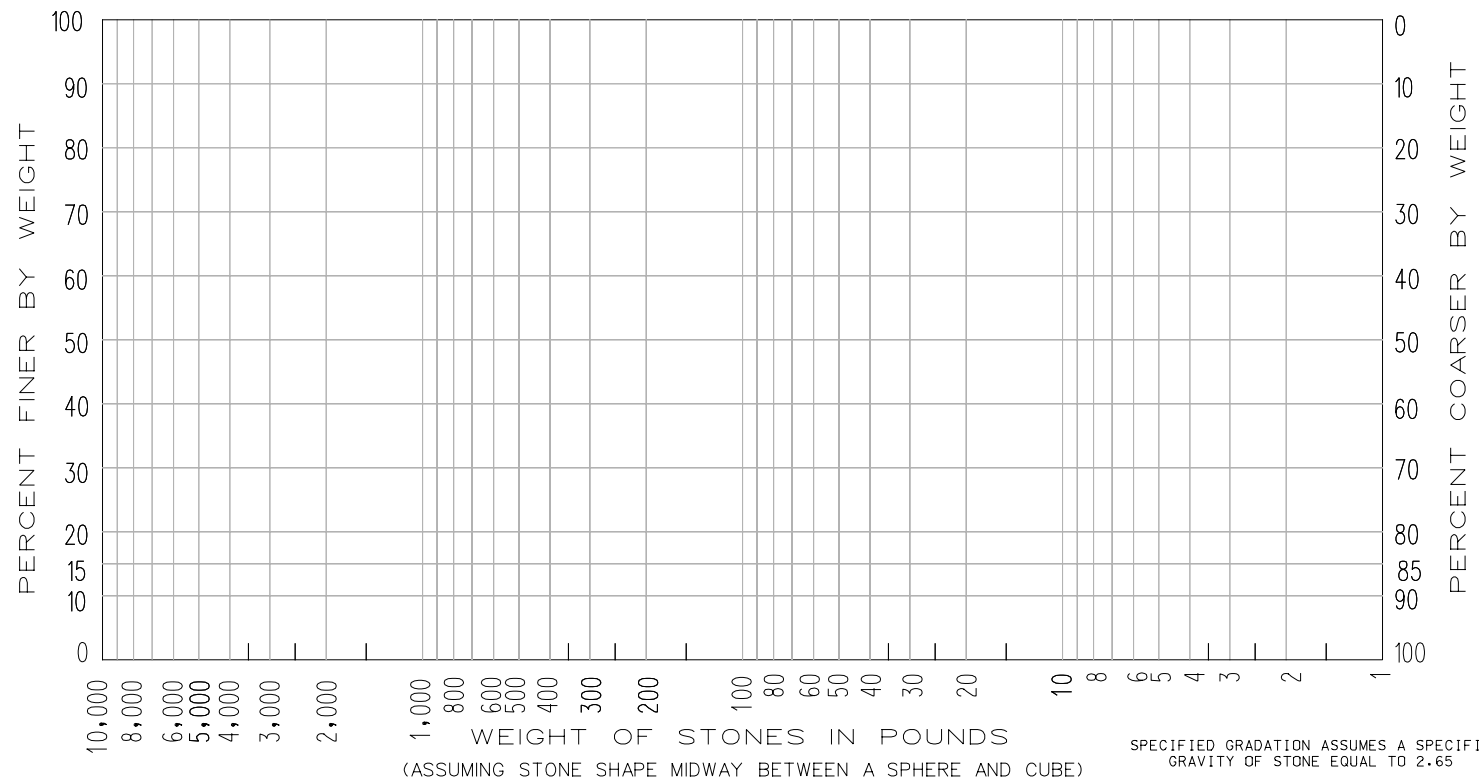
3.5 CONTRACTOR QUALITY CONTROL

The Contractor shall establish and maintain quality control for all work performed at the job site under this section to assure compliance with contract requirements. He shall maintain records of his quality control tests, inspections and corrective actions. Quality control measures shall cover all construction operations including, but not limited to, the placement of all materials to the slope and grade lines shown and in accordance with this section.

In addition to the Contractor's system to establish and maintain quality control for stone placement operations, the following information shall be recorded and promptly provided to the Contracting Officer on request:

- a. Record tonnage of stone placed in completed sections of the work and check quantity for compliance with design sections.
- b. Check for uniform thickness of material layers.

-- End of Section --



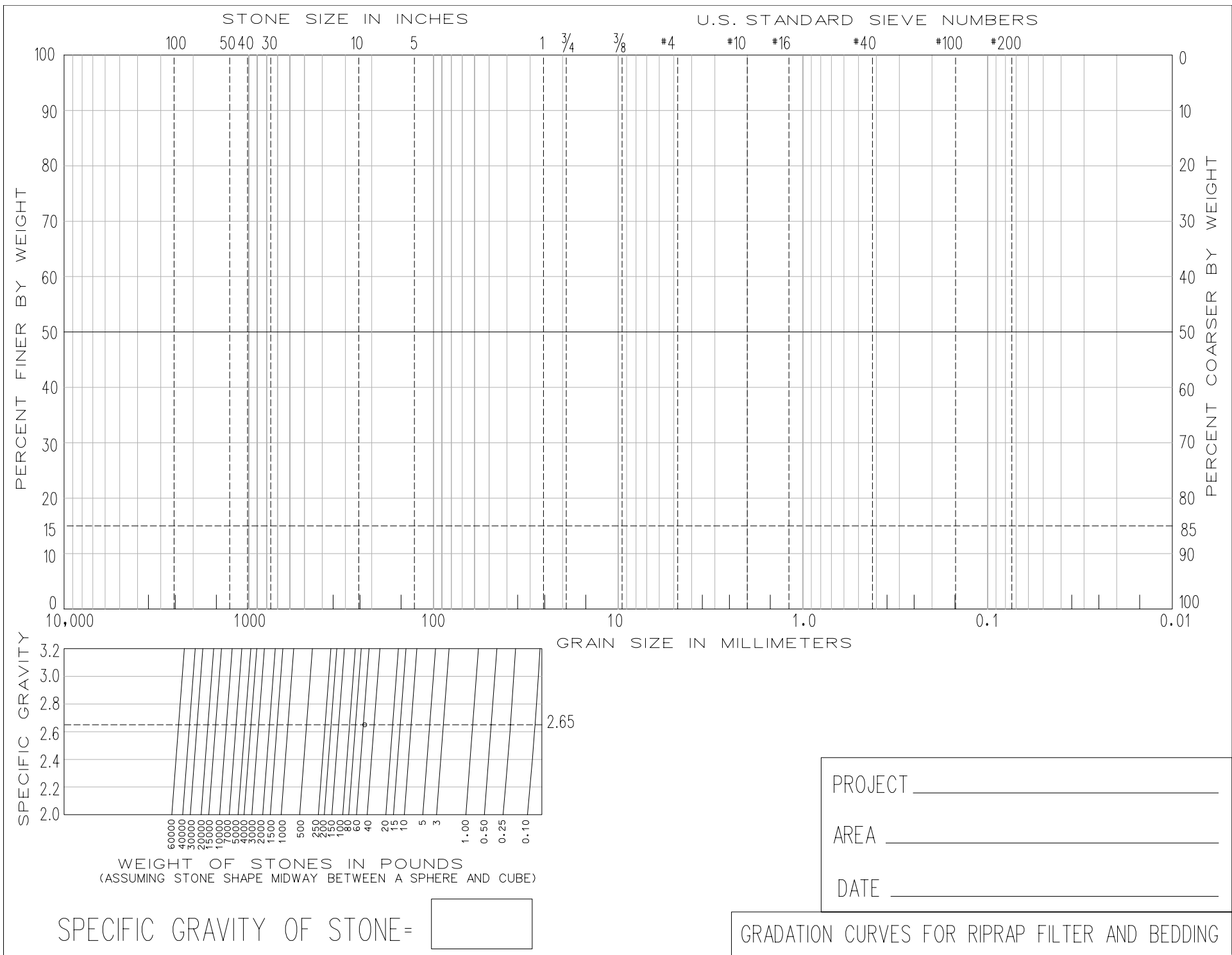
SPECIFIC GRAVITY OF STONE=

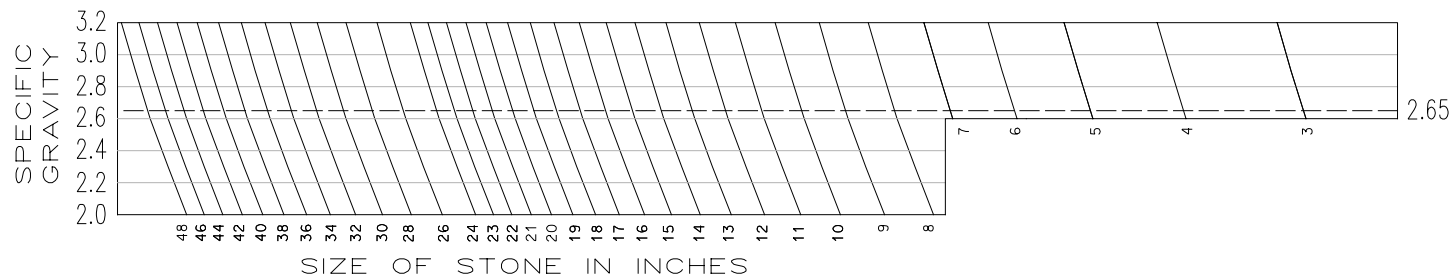
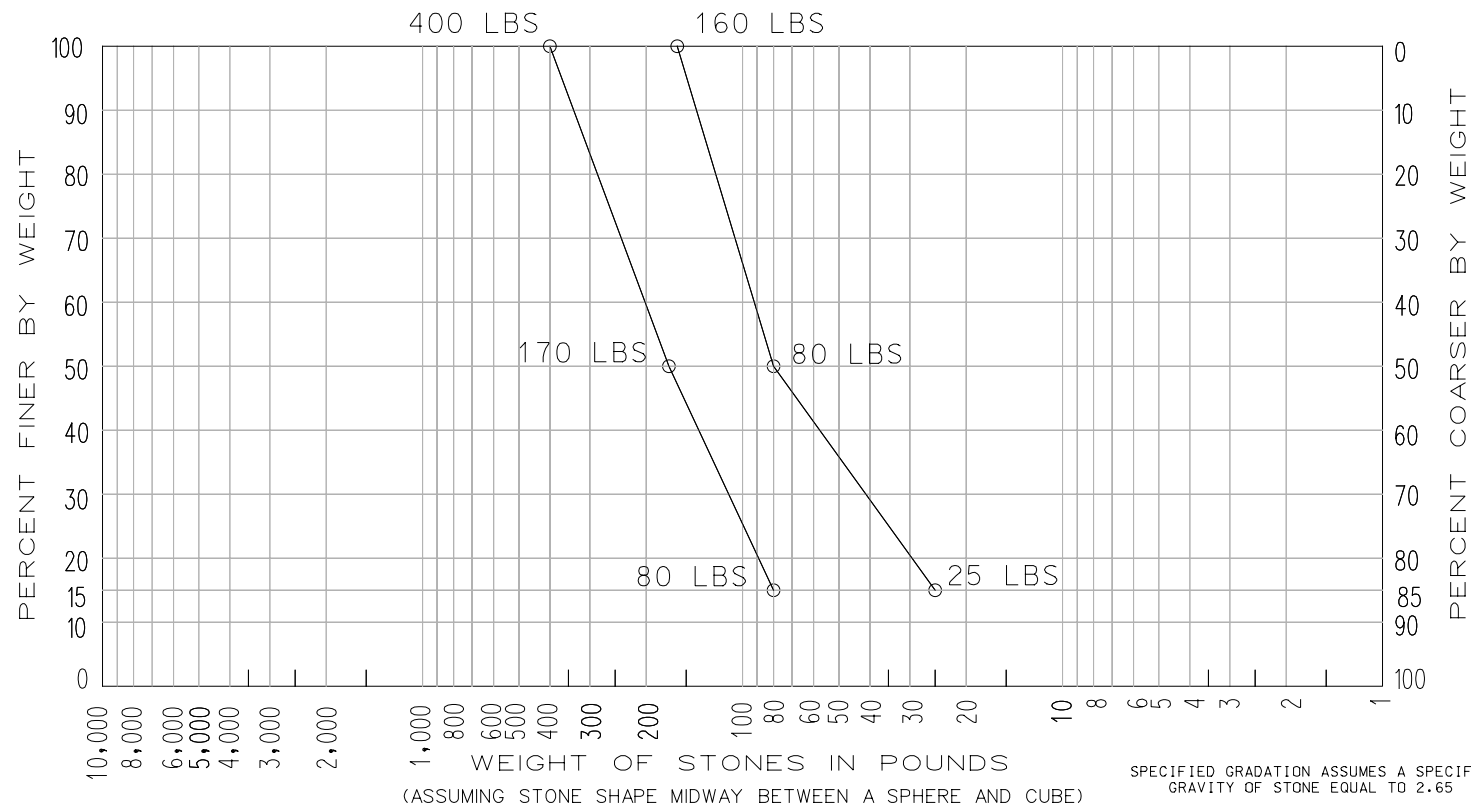
PROJECT _____

AREA _____

DATE _____

RIPRAP/ROCKFILL GRADATION CURVE





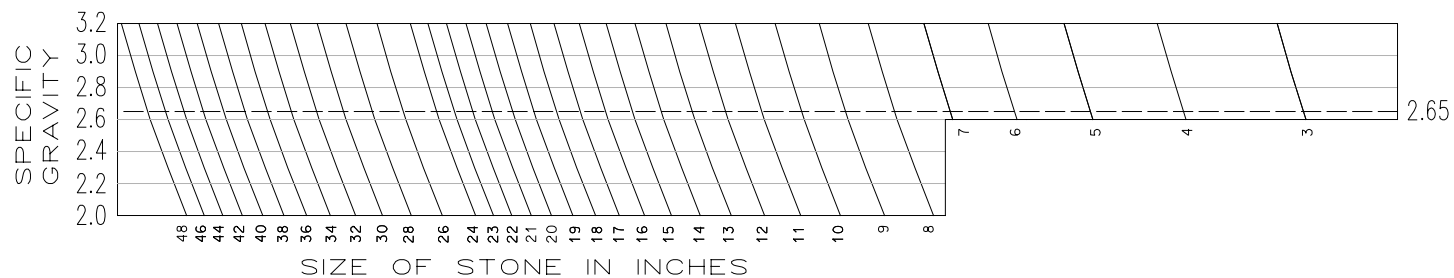
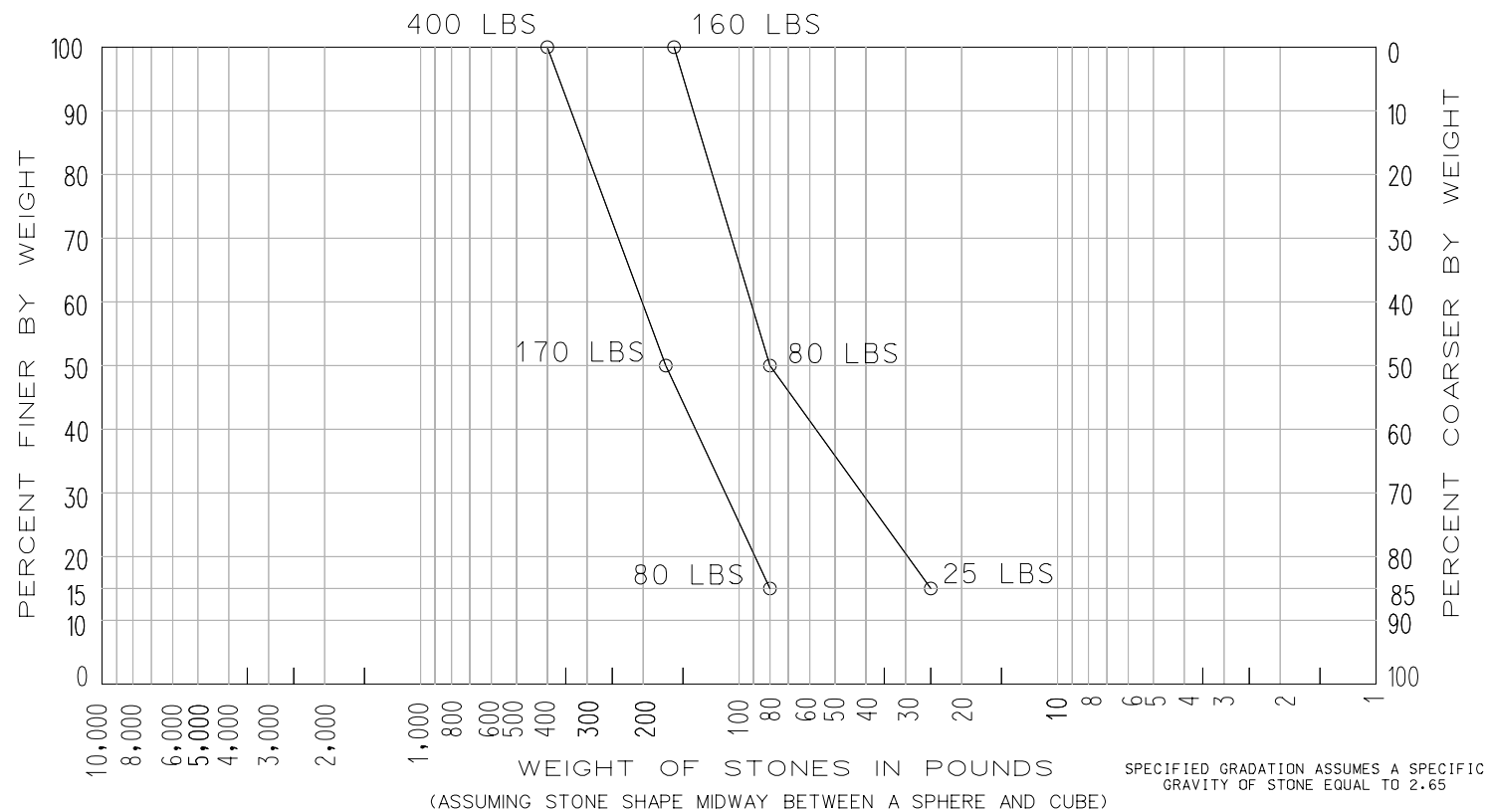
SPECIFIC GRAVITY OF STONE= 2.65

PROJECT EAST GRAND FORKS, MINNESOTA

AREA R270 RIPRAP

DATE 01/22/01

RIPRAP/ROCKFILL GRADATION CURVE



SPECIFIC GRAVITY OF STONE= 2.65

PROJECT EAST GRAND FORKS, MINNESOTA

AREA R80 RIPRAP

DATE 01/22/01

RIPRAP/ROCKFILL GRADATION CURVE

WORK SHEET FOR GRADATION ANALYSIS OF RIPRAP METHOD A

Project Name:	Date:

Riprap Type:	Test No.
Source, Quarry, or Pit:	

Sample Location:		Test Made By:
------------------	--	---------------

Part 1. Weigh all stones larger than 5 pounds and record.

[illegible]

Rows (1) & (2) Enter 5 to 7 weight classes to yield approx. 75%, 50%, 30%, and 15% finer points.

Row (3) List weight of each stone. Attach additional sheets if necessary.

Row (4) Add all individual stone weights listed in each column.

Row (4) Add all individual stone weights listed in each column.

Part 2. Summary Table.

(5) WEIGHT CLASSES	(6)	(7)	(8)
--------------------	-----	-----	-----

PASSING (stone wt. in lbs.)	RETAINED (stone wt. in lbs.)	TOTAL WEIGHT EACH CLASS (lbs.)	CUMMULATIVE WEIGHT PASSING (lbs.)	TOTAL PERCENT PASSING (%)
	5 lbs.			
5 lbs.	PAN			
SAMPLE TOTAL			-----	-----

Column (5)	Enter same weight classes used in Rows (1) and (2).
Column (6)	Enter weights of material from Row (4)
Column (7)	Add column (6) from bottom up to get cumulative weight passing.
Column (8)	Divide column (7) by sample total to get total percent passing.

Column (7) Add column (6) from bottom up to get cumulative weight passing.
Column (8) Divide column (7) by sample total to get total percent passing.

Column (8) Divide column (7) by sample total to get total percent passing.

WORK SHEET FOR GRADATION ANALYSIS OF RIPRAP METHOD B

Project Name:	Date:
Riprap Type:	Test No.
Source, Quarry, or Pit:	
Sample Location:	Test Made By:

Part 1. Separate rock into 5 to 7 piles, ordered by size. The largest pile should contain 2 to 5 stones. Intermediate piles between the largest stones and those smaller than 5 pounds should be approximately equal in total weight. Separate all stones before weighing.

Part 2. Summary Table.

(1) WEIGHT CLASSES		(2)	(3)	(4)
PASSING (stone wt. in lbs.)	RETAINED (stone wt. in lbs.)	TOTAL WEIGHT EACH CLASS (lbs.)	CUMMULATIVE WEIGHT PASSING (lbs.)	TOTAL PERCENT PASSING (%)
	5 lbs.			
5 lbs.	PAN			
SAMPLE TOTAL			-----	-----

Column (1) Weight the smallest and largest stone in each pile. If weight classes overlap, adjust stones as necessary and repeat.

Column (2) Weigh the total amount of rock in each pile and record.

Column (3) Add column (2) from bottom up to get cumulative weight passing.

Column (4) Divide column (3) by sample total to get total percent passing.

SECTION TABLE OF CONTENTS

DIVISION 02 - SITE WORK

SECTION 02464

METAL SHEET PILING

04/01

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 SUBMITTALS
- 1.3 DELIVERY, STORAGE AND HANDLING

PART 2 PRODUCTS

- 2.1 METAL SHEET PILING
- 2.2 WELDING ELECTRODES
- 2.3 APPURTENANT METAL MATERIALS
- 2.4 TESTS, INSPECTIONS, AND VERIFICATIONS
 - 2.4.1 Material Tests
 - 2.4.2 Interlocked Joint Strength in Tension Test

PART 3 EXECUTION

- 3.1 INSTALLATION
 - 3.1.1 Pile Driving Equipment
 - 3.1.1.1 Driving Hammers
 - 3.1.2 Placing and Driving
 - 3.1.2.1 Placing
 - 3.1.2.2 Driving
 - 3.1.3 Splicing
 - 3.1.4 Inspection of Driven Piling
- 3.2 REMOVAL
 - 3.2.1 Pulling

-- End of Section Table of Contents --

SECTION 02464

METAL SHEET PILING

04/01

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 6	(1995b) General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling
ASTM A 36	(1996) Carbon Structural Steel
ASTM A 325	Structural Bolts, Steel, Heat Treated, .20/105 ksi Minimum Tensile Strength
ASTM A 328	(1993a) Steel Sheet Piling

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1	Structural Welding Codes
AWS D2.3	Structural Welding Code Sheet Steel

1.2 SUBMITTALS

Government approval is required for all submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with SECTION 01330 SUBMITTAL PROCEDURES:

SD-04 Drawings

Metal Sheet Piling; GA.

Detail drawings for sheet piling including fabricated sections shall show complete piling dimensions and details, driving sequence and location of installed piling. Detail drawings shall include details and dimensions of templates and other temporary guide structures for installing piling. Detail drawings shall provide details of the method of handling piling to prevent permanent deflection, distortion or damage to piling interlocks.

Pile Driving Equipment; GA

Complete descriptions of sheet piling driving equipment including hammers, extractors, protection caps and other installation appurtenances shall be submitted for approval prior to commencement of work.

SD-08 Statements

Pulling and Redriving; GA.

The proposed method of pulling sheet piling shall be submitted and approved prior to pulling any piling.

Interlocked Joint Strength in Tension Test; GA

The procedure for testing sheet piling interlocked joint strength in tension shall be submitted and approved prior to testing piling.

Materials Tests; FIO.

Certified materials tests reports showing that sheet piling and appurtenant metal materials meet the specified requirements shall be submitted for each shipment and identified with specific lots prior to installing materials. Material test reports shall meet the requirements of ASTM A 6.

SD-18 Records

Driving; FIO.

Records of the sheet piling driving operations shall be submitted after driving is completed. These records shall provide a system of identification which shows the disposition of approved piling in the work, driving equipment performance data, piling penetration rate data, piling dimensions and top and bottom elevations of installed piling. The format for driving records shall be as directed.

1.3 DELIVERY, STORAGE AND HANDLING

Materials delivered to the site shall be new and undamaged and shall be accompanied by certified test reports. The manufacturer's logo and mill identification mark shall be provided on the sheet piling as required by the referenced specifications. Sheet piling shall be stored and handled in the manner recommended by the manufacturer to prevent permanent deflection, distortion or damage to the interlocks. Storage of sheet piling should also facilitate required inspection activities. Sheet piling over 80 feet in length shall be handled using a minimum of two pickup points.

PART 2 PRODUCTS

2.1 METAL SHEET PILING

Metal sheet piling shall be continuously interlocking hot-rolled steel sections conforming to ASTM A 328. The interlocks of sheet piling shall be

free-sliding, provide a swing angle suitable for the intended installation but not less than 5 degrees when interlocked, and maintain continuous interlocking when installed. Fabricated bends, tees, wyes and cross pieces shall be fabricated as appropriate with ASTM A 328 piling, and shall be fabricated from matching pieces of sheet piling, ASTM A 36 plates or angles, and ASTM A 325 high strength bolts. The web thickness and the welded or bolted connection shear and tension capacity shall meet or exceed that of the piece to which it connects. Sheet piling shall be provided with standard pulling holes. The PZ designation is listed for identifier only. Pieces, including fabricated sections, shall be of the type indicated in the Drawings with minimum properties as listed in the following table.

Minimum Properties of Pile Sections

Type of Section	Nominal Web Thickness (Inches)	Section Modulus per Lineal Foot of Wall (Cubic Inches)	Weight per Square Foot of Wall (lbs)
PZ-22	0.310	14	19
PZ-40	0.450	59	39

Metalwork fabrication for sheet piling shall be as specified and in SECTION 05055: METALWORK FABRICATION, MACHINE WORK, AND MISCELLANEOUS PROVISIONS.

2.2 WELDING ELECTRODES

AWS D1.1 and AWS D2.3 E70 Electrode.

2.3 APPURTENANT METAL MATERIALS

Metal plates, shapes, bolts, nuts, rivets and other appurtenant fabrication and installation materials shall conform to manufacturer's standards and to the requirements specified in the respective sheet piling standards and in SECTION 05055: METALWORK FABRICATION, MACHINE WORK, AND MISCELLANEOUS PROVISIONS

2.4 TESTS, INSPECTIONS, AND VERIFICATIONS

Requirements for material tests, workmanship and other measures for quality assurance shall be as specified and in Section 05055 METALWORK FABRICATION, MACHINE WORK, AND MISCELLANEOUS PROVISIONS.

2.4.1 Material Tests

Material tests shall conform to the following requirements. Sheet piling and appurtenant materials shall be tested and certified by the manufacturer to meet the specified chemical, mechanical and section property requirements prior to delivery to the site. Testing of sheet piling for mechanical properties shall be performed after the completion of all rolling and forming operations. Testing of sheet piling shall meet the requirements of ASTM A 6.

2.4.2 Interlocked Joint Strength in Tension Test

The interlocked joint strength in tension test shall conform to the piling manufacturer's standard test, include testing at least two 3 inch long coupons taken randomly from different as-produced pilings of each heat and must be approved.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Pile Driving Equipment

Pile driving equipment shall conform to the following requirements.

3.1.1.1 Driving Hammers

Hammers shall be steam, air, or diesel drop, single-acting, double-acting, differential-acting, or vibratory type. The driving energy of the hammers shall be as recommended by the manufacturer for the piling weights and lengths and the subsurface materials to be encountered.

3.1.2 Placing and Driving

3.1.2.1 Placing

Any excavation required within the area where sheet pilings are to be installed shall be completed prior to placing sheet pilings. Pilings to be placed in cofferdam cells and connecting arcs shall be picked up and completely threaded to demonstrate that they slide freely in interlock. Pilings shall be carefully located as directed by Soils Engineer. Pilings shall be placed plumb with out-of-plumbness not exceeding 1/8 inch per foot of length and true to line. Temporary wales, templates, master pilings, current deflectors, or guide structures shall be provided to insure that the pilings are placed and driven to the correct alignment. At least two templates shall be used in placing each piling and the maximum spacing of templates shall not exceed 20 feet. Pilings properly placed and driven shall be interlocked throughout their length with adjacent pilings to form a continuous diaphragm throughout the length or run of piling wall.

3.1.2.2 Driving

Prior to driving pilings in water a horizontal line shall be painted on both sides of each piling at a fixed distance from the bottom so that it shall be visible above the water line after installation. This line shall indicate the profile of the bottom elevation of installed pilings and potential problem areas can be identified by abrupt changes in its elevation. Pilings shall be driven with the proper size hammer and by approved methods so as not to subject the pilings to damage and to ensure proper interlocking throughout their lengths. Caution shall be taken in the sustained use of vibratory hammers when a hard driving condition is encountered to avoid interlock-melt or damages. The use of vibratory hammers should be discontinued and impact hammers employed when the

penetration rate due to vibratory loading is one foot or less per minute. Pilings damaged during driving or driven out of interlock shall be removed and replaced at the Contractor's expense. Damaged sheet piles include but are not necessarily limited to sheet piles bent, buckled, cracked, with fabrication tolerances beyond those indicated in ASTM A 328, or with any other defect as determined by the Engineer would weaken the sheet pile. Piling shall be driven without the aid of a water jet. Adequate precautions shall be taken to insure that pilings are driven plumb. If at any time the forward or leading edge of the piling wall is found to be out-of-plumb in the plane of the wall the piling being driven shall be driven to the required depth and tapered pilings shall be provided and driven to interlock with the out-of-plumb leading edge or other approved corrective measures shall be taken to insure the plumbness of succeeding pilings. The maximum permissible taper for any tapered piling shall be 1/8 inch per foot of length. Pilings in each run or continuous length of piling wall shall be driven alternately in increments of depth to the required depth or elevation. No piling shall be driven to a lower elevation than those behind it in the same run except when the pilings behind it cannot be driven deeper. If the piling next to the one being driven tends to follow below final elevation it may be pinned to the next adjacent piling. At least the first two sheets of the connecting arcs adjacent to the main cells shall be driven in the cofferdam cells prior to filling the cells. Pilings shall not be driven within 100 feet of concrete less than 7 days old.

3.1.3 Splicing

Pilings adjoining spliced pilings shall be full length unless otherwise approved. Splicing of pilings shall be as indicated. Ends of pilings to be spliced shall be squared before splicing to eliminate dips or camber. Pilings shall be spliced together with concentric alignment of the interlocks so that there are no discontinuities, dips or camber at the abutting interlocks. Spliced pilings shall be free sliding and able to obtain the maximum swing with contiguous pilings. Bolt holes in steel piling shall be drilled or may be burned and reamed by approved methods which will not damage the surrounding metal. All holes in steel pilings on the wet side of cofferdams shall be made watertight by welding steel plates over the holes after the piling installation is completed.

3.1.4 Inspection of Driven Piling

The Contractor shall inspect the interlocked joints of driven pilings extending above ground. Pilings found to be out of interlock shall be removed and replaced at the Contractor's expense.

3.2 REMOVAL

3.2.1 Pulling

The method of pulling piling must be approved. Pulling holes shall be provided in pilings as required. Extractors shall be of suitable type and size. Care shall be exercised during pulling of pilings to avoid damaging piling interlocks and adjacent construction. If the Contracting Officer determines that adjacent permanent construction has been damaged during

pulling the Contractor will be required to repair this construction at no cost to the Government. Pilings shall be pulled one sheet at a time. Pilings fused together shall be separated prior to pulling unless the Contractor demonstrates to the satisfaction of the Contracting Officer that the pilings cannot be separated. The Contractor will not be paid for the removal of pilings damaged beyond structural use due to proper care not being exercised during pulling.

-- End of Section --

SECTION TABLE OF CONTENTS

DIVISION 02 - SITE WORK

SECTION 02510

WATER DISTRIBUTION SYSTEM

04/01

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 PIPING
 - 1.2.1 Service Lines
 - 1.2.2 Excavation, Trenching, and Backfilling
- 1.3 SUBMITTALS
- 1.4 HANDLING

PART 2 PRODUCTS

- 2.1 PIPE
 - 2.1.1 Plastic Pipe
 - 2.1.1.1 PVC Plastic Pipe
 - 2.1.2 Copper Tubing
- 2.2 FITTINGS AND SPECIALS
 - 2.2.1 PVC Pipe System
 - 2.2.2 Copper Tubing System
- 2.3 JOINTS
 - 2.3.1 PVC Pipe
 - 2.3.2 Copper Tubing Jointing
- 2.4 VALVES
 - 2.4.1 Gate Valves
- 2.5 MISCELLANEOUS ITEMS
 - 2.5.1 Service Clamps
 - 2.5.2 Corporation Stops
 - 2.5.3 Goosenecks
 - 2.5.4 Service Stops
 - 2.5.5 Tapping Sleeves
 - 2.5.6 Service Boxes
 - 2.5.7 Disinfection
 - 2.5.8 Meters
- 2.6 VALVE BOXES
- 2.7 INSULATION

PART 3 EXECUTION

- 3.1 INSTALLATION
 - 3.1.1 Cutting of Pipe
 - 3.1.2 Adjacent Facilities
 - 3.1.2.1 Sewer Lines

- 3.1.2.2 Water Lines
- 3.1.2.3 Copper Tubing Lines
- 3.1.2.4 Nonferrous Metallic Pipe
- 3.1.3 Joint Deflection
 - 3.1.3.1 Offset for Flexible Plastic Pipe
- 3.1.4 Placing and Laying
 - 3.1.4.1 Piping Connections
 - 3.1.4.2 Plastic Pipe Installation
- 3.1.5 Jointing
 - 3.1.5.1 PVC Plastic Pipe Requirements
 - 3.1.5.2 Copper Tubing Requirements
- 3.1.6 Installation of Service Lines
 - 3.1.6.1 Service Lines 2 Inches and Smaller
- 3.1.7 Setting of Meters and Valves
 - 3.1.7.1 Location of Meters
 - 3.1.7.2 Location of Valves
- 3.1.8 Thrust Restraint
 - 3.1.8.1 Thrust Blocks
 - 3.1.8.2 Restrained Joints
- 3.1.9 Pipe Encasement
- 3.1.10 Insulation
- 3.2 HYDROSTATIC TESTS
 - 3.2.1 Pressure Test
 - 3.2.2 Leakage Test
 - 3.2.3 Time for Making Test
 - 3.2.4 Concurrent Hydrostatic Tests
- 3.3 BACTERIAL DISINFECTION
 - 3.3.1 Bacteriological Disinfection
- 3.4 CLEANUP

-- End of Section Table of Contents --

SECTION 02510

WATER DISTRIBUTION SYSTEM

04/01

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 36/A 36M	(1997a) Carbon Structural Steel
ASTM A 53	(1998) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded, and Seamless
ASTM B 88	(1996) Seamless Copper Water Tube
ASTM B 88M	(1996) Seamless Copper Water Tube (Metric)
ASTM C 76	(1998) Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
ASTM C 76M	(1998) Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe (Metric)
ASTM D 1599	(1988; R 1995) Short-Time Hydraulic Failure Pressure of Plastic Pipe, Tubing, and Fittings
ASTM D 1784	(1999) Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
ASTM D 1785	(1996b) Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
ASTM D 2241	(1996b) Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)
ASTM D 2464	(1996a) Threaded Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
ASTM D 2466	(1997) Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40

ASTM D 2467	(1996a) Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
ASTM D 2564	(1996a) Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems
ASTM D 2657	(1997) Heat Fusion Joining Polyolefin Pipe and Fittings
ASTM D 2774	(1994) Underground Installation of Thermoplastic Pressure Piping
ASTM D 2842	Test Method for Water Absorption of Rigid Plastics
ASTM D 2855	(1996) Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings
ASTM D 2996	(1995) Filament-Wound "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe
ASTM D 2997	(1995) Centrifugally Cast "Fiberglass" (Glass-Fiber-Reinforced-Thermosetting-Resin) Pipe
ASTM D 3139	(1998) Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
ASTM D 3839	(1994a) Underground Installation of "Fiberglass" (Glass-Fiber-Reinforced Thermosetting Resin) Pipe
ASTM D 4161	(1996) "Fiberglass" (Glass-Fiber-Reinforced Thermosetting Resin) Pipe Joints Using Elastomeric Seals
ASTM F 477	(1996a) Elastomeric Seals (Gaskets) for Joining Plastic Pipe
ASTM F 1483	(1998) Oriented Poly(Vinyl Chloride), PVC0, Pressure Pipe

ASME INTERNATIONAL (ASME)

ASME B1.20.1	(1983; R 1992) Pipe Threads, General Purpose (Inch)
ASME B16.1	(1989) Cast Iron Pipe Flanges and Flanged Fittings
ASME B16.3	(1992) Malleable Iron Threaded Fittings

ASME B16.26 (1988) Cast Copper Alloy Fittings for
Flared Copper Tubes

ASME B36.10M (1996) Welded and Seamless Wrought Steel
Pipe

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA B300 (1992) Hypochlorites

AWWA B301 (1992) Liquid Chlorine

AWWA C104 (1995) Cement-Mortar Lining for
Ductile-Iron Pipe and Fittings for Water

AWWA C105 (1993) Polyethylene Encasement for
Ductile-Iron Pipe Systems

AWWA C110 (1993) Ductile-Iron and Gray-Iron
Fittings, 3 In. Through 48 In. (75 mm
through 1200 mm), for Water and Other
Liquids

AWWA C111 (1995) Rubber-Gasket Joints for
Ductile-Iron Pressure Pipe and Fittings

AWWA C115 (1996) Flanged Ductile-Iron Pipe With
Ductile-Iron or Gray-Iron Threaded Flanges

AWWA C151 (1996) Ductile-Iron Pipe, Centrifugally
Cast, for Water or Other Liquids

AWWA C153 (1994; Errata Nov 1996) Ductile-Iron
Compact Fittings, 3 In. Through 24 In. (76
mm through 610 mm) and 54 In. through 64
In. (1,400 mm through 1,600 mm) for Water
Service

AWWA C200 (1997) Steel Water Pipe - 6 In. (150 mm)
and Larger

AWWA C203 (1997) Coal-Tar Protective Coatings and
Linings for Steel Water Pipelines - Enamel
and Tape - Hot-Applied

AWWA C205 (1995) Cement-Mortar Protective Lining and
Coating for Steel Water Pipe - 4 In. (100
mm) and Larger - Shop Applied

AWWA C207 (1994) Steel Pipe Flanges for Waterworks
Service - Sizes 4 In. Through 144 In. (100
mm through 3,600 mm)

AWWA C208 (1996) Dimensions for Fabricated Steel

Water Pipe Fittings

AWWA C300	(1997) Reinforced Concrete Pressure Pipe, Steel-Cylinder Type, for Water and Other Liquids
AWWA C301	(1992) Prestressed Concrete Pressure Pipe, Steel-Cylinder Type, for Water and Other Liquids
AWWA C303	(1995) Concrete Pressure Pipe, Bar-Wrapped, Steel Cylinder Type
AWWA C500	(1993; C500a) Metal-Sealed Gate Valves for Water Supply Service
AWWA C502	(1994; C502a) Dry-Barrel Fire Hydrants
AWWA C503	(1997) Wet-Barrel Fire Hydrants
AWWA C504	(1994) Rubber-Seated Butterfly Valves
AWWA C509	(1994) Resilient-Seated Gate Valves for Water Supply Service
AWWA C600	(1993) Installation of Ductile-Iron Water Mains and Their Appurtenances
AWWA C606	(1997) Grooved and Shouldered Joints
AWWA C651	(1992) Disinfecting Water Mains
AWWA C700	(1995) Cold-Water Meters - Displacement Type, Bronze Main Case
AWWA C701	(1988) Cold-Water Meters - Turbine Type, for Customer Service
AWWA C702	(1992) Cold-Water Meters - Compound Type
AWWA C703	(1996) Cold-Water Meters - Fire Service Type
AWWA C704	(1992) Propeller-Type Meters Waterworks Applications
AWWA C706	(1996) Direct-Reading, Remote-Registration Systems for Cold-Water Meters
AWWA C707	(1982; R 1992) Encoder-Type Remote-Registration Systems for Cold-Water Meters
AWWA C800	(1989) Underground Service Line Valves and

Fittings

AWWA C900	(1997; C900a Polyvinyl Chloride (PVC) Pressure Pipe, 4 In. Through 12 In., for Water Distribution
AWWA C901	(1996) Polyethylene (PE) Pressure Pipe and Tubing, 1/2 In. Through 3 In., for Water Service
AWWA C905	(1997) Polyvinyl Chloride (PVC) Water Transmission Pipe, Nominal Diameters 14 In. Through 36 In.
AWWA C950	(1995) Fiberglass Pressure Pipe
AWWA M23	(1980) Manual: PVC Pipe - Design and Installation

ASBESTOS CEMENT PIPE PRODUCERS ASSOCIATION (ACPPA)

ACPPA Work Practices	(1988) Recommended Work Practices for A/C Pipe
----------------------	--

DUCTILE IRON PIPE RESEARCH ASSOCIATION (DIPRA)

DIPRA-Restraint Design	(1997) Thrust Restraint Design for Ductile Iron Pipe
------------------------	--

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-80	(1997) Bronze Gate, Globe, Angle and Check Valves
-----------	---

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 24	(1995) Installation of Private Fire Service Mains and Their Appurtenances
NFPA 49	(1994) Hazardous Chemicals Data
NFPA 325-1	(1994) Fire Hazard Properties of Flammable Liquids, Gases, and Volatile Solids
NFPA 704	(1996) Identification of the Fire Hazards of Materials for Emergency Response
NFPA 1961	(1997) Fire Hose

NSF INTERNATIONAL (NSF)

NSF 14	(1998) Plastics Piping Components and Related Materials
--------	---

NSF 61 (1998) Drinking Water System Components -
Health Effects (Sections 1-9)

STEEL STRUCTURES PAINTING COUNCIL (SSPC)

SSPC Paint 21 (1991) White or Colored Silicone Alkyd
Paint

SSPC Paint 25 (1991) Red Iron Oxide, Zinc Oxide, Raw
Linseed Oil and Alkyd Primer (Without Lead
and Chromate Pigments)

1.2 PIPING

This section covers water service lines, and connections to building service at a point approximately 5 feet outside buildings and structures to which service is required. The Contractor shall have a copy of the manufacturer's recommendations for each material or procedure to be utilized available at the construction site at all times.

1.2.1 Service Lines

Piping for water service lines shall be copper tubing, unless otherwise shown or specified.

1.2.2 Excavation, Trenching, and Backfilling

Excavation, trenching, and backfilling shall be in accordance with the applicable provisions of Section 02316 EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS, except as modified herein.

1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having a "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-08 Statements

Waste Water Disposal Method; GA.

The method proposed for disposal of waste water from hydrostatic tests and disinfection, prior to performing hydrostatic tests.

Satisfactory Installation; FIO.

A statement signed by the principal officer of the contracting firm stating that the installation is satisfactory and in accordance with the contract drawings and specifications, and the manufacturer's prescribed procedures and techniques, upon completion of the project and before final acceptance.

1.4 HANDLING

Pipe and accessories shall be handled to ensure delivery to the trench in sound, undamaged condition, including no injury to the pipe coating or lining. If the coating or lining of any pipe or fitting is damaged, the repair shall be made by the Contractor in a satisfactory manner, at no additional cost to the Government. No other pipe or material shall be placed inside a pipe or fitting after the coating has been applied. Pipe shall be carried into position and not dragged. Use of pinch bars and tongs for aligning or turning pipe will be permitted only on the bare ends of the pipe. The interior of pipe and accessories shall be thoroughly cleaned of foreign matter before being lowered into the trench and shall be kept clean during laying operations by plugging or other approved method. Before installation, the pipe shall be inspected for defects. Material found to be defective before or after laying shall be replaced with sound material without additional expense to the Government. Rubber gaskets that are not to be installed immediately shall be stored in a cool and dark place.

PART 2 PRODUCTS

2.1 PIPE

Pipe shall conform to the respective specifications and other requirements specified below.

2.1.1 Plastic Pipe

2.1.1.1 PVC Plastic Pipe

a. Pipe 4 through 12 inch diameter: Pipe couplings and fittings shall conform to AWWA C900, Class 150, CIOD pipe dimensions, elastomeric-gasket joint, unless otherwise shown or specified.

b. Pipe 14 through 36 inch diameter: Pipe shall conform to AWWA C905 unless otherwise shown or specified.

2.1.2 Copper Tubing

Copper tubing shall conform to ASTM B 88, Type K, annealed.

2.2 FITTINGS AND SPECIALS

2.2.1 PVC Pipe System

For pipe 4 inch diameter and larger, fittings and specials shall be iron, bell end in accordance with AWWA C110, 150 psi pressure rating unless otherwise shown or specified, except that profile of bell may have special dimensions as required by the pipe manufacturer; or fittings and specials may be of the same material as the pipe with elastomeric gaskets, all in conformance with AWWA C900. Iron fittings and specials shall be cement-mortar lined (standard thickness) in accordance with AWWA C104. Fittings shall be bell and spigot or plain end pipe, or as applicable. Ductile iron compact fittings shall be in accordance with AWWA C153.

2.2.2 Copper Tubing System

Fittings and specials shall be flared and conform to ASME B16.26.

2.3 JOINTS

2.3.1 PVC Pipe

Joints, fittings, and couplings shall be as specified for PVC Pipe. Joints connecting pipe of differing materials shall be mechanical joints or as recommended by the manufacturer, subject to the approval of the Contracting Officer.

2.3.2 Copper Tubing Jointing

Joints shall be compression-pattern flared and shall be made with the specified fittings.

2.4 VALVES

2.4.1 Gate Valves

Gate valves shall be designed for a working pressure of not less than 150 psi. Valve connections shall be as required for the piping in which they are installed. Valves shall have a clear waterway equal to the full nominal diameter of the valve, and shall be opened by turning counterclockwise. The operating nut or wheel shall have an arrow, cast in the metal, indicating the direction of the opening.

- a. Valves 3 inches and larger shall be iron body, bronze mounted, and shall conform to AWWA C500. Flanges shall not be buried. An approved pit shall be provided for all flanged connections.

2.5 MISCELLANEOUS ITEMS

2.5.1 Service Clamps

Service clamps shall have a pressure rating not less than that of the pipe to be connected and shall be either the single or double flattened strap type. Clamps shall have a galvanized malleable-iron body with cadmium plated straps and nuts. Clamps shall have a rubber gasket cemented to the body.

2.5.2 Corporation Stops

Corporation stops shall have standard corporation stop thread conforming to AWWA C800 on the inlet end, with flanged joints, compression pattern flared tube couplings, or wiped joints for connections to goosenecks.

2.5.3 Goosenecks

Copper tubing for gooseneck connections shall conform to the applicable requirements of ASTM B 88, Type K, annealed. Length of cable requirement

connections shall be in accordance with standard practice.

2.5.4 Service Stops

Service stops shall be water-works inverted-ground-key type, oval or round flow way, tee handle, without drain. Pipe connections shall be suitable for the type of service pipe used. All parts shall be of bronze with female iron-pipe-size connections or compression-pattern flared tube couplings, and shall be designed for a hydrostatic test pressure not less than 200 psi.

2.5.5 Tapping Sleeves

Tapping sleeves of the sizes indicated for connection to existing main shall be the cast gray, ductile, or malleable iron, split-sleeve type with flanged or grooved outlet, and with bolts, follower rings and gaskets on each end of the sleeve. Construction shall be suitable for a maximum working pressure of 150 psi. Bolts shall have square heads and hexagonal nuts. Longitudinal gaskets and mechanical joints with gaskets shall be as recommended by the manufacturer of the sleeve. When using grooved mechanical tee, it shall consist of an upper housing with full locating collar for rigid positioning which engages a machine-cut hole in pipe, encasing an elastomeric gasket which conforms to the pipe outside diameter around the hole and a lower housing with positioning lugs, secured together during assembly by nuts and bolts as specified, pretorqued to 50 foot-pound.

2.5.6 Service Boxes

Service boxes shall be cast iron or concrete and shall be extension service boxes of the length required for the depth of the line, with either screw or slide-type adjustment. The boxes shall have housings of sufficient size to completely cover the service stop or valve and shall be complete with identifying covers.

2.5.7 Disinfection

Chlorinating materials shall conform to the following:

Chlorine, Liquid: AWWA B301.

Hypochlorite, Calcium and Sodium: AWWA B300.

2.5.8 Meters

Water meters for the rest rooms shall be purchased by the Contractor from the City of East Grand Forks Water and Light Department (218)773-1163.

2.6 VALVE BOXES

Valve boxes shall be cast iron or concrete, except that concrete boxes may be installed only in locations not subjected to vehicular traffic. Cast-iron boxes shall be extension type with slide-type adjustment and with flared base. The minimum thickness of metal shall be 3/16 inch. Concrete boxes shall be the standard product of a manufacturer of precast concrete equipment. The word "WATER" shall be cast in the cover. The box length

shall adapt, without full extension, to the depth of cover required over the pipe at the valve location.

2.7 INSULATION

Insulation shall be rigid, extruded polystyrene board with minimum thermal resistance (R) of 5.0. Board size shall be 48-inch x 96-inch. Edges shall be square. Compressive strength shall be minimum 25 psi. Water absorption shall be maximum 0.1 percent in accordance with ASTM D 2842. Minimum thickness of individual boards shall be 1-inch.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Cutting of Pipe

Cutting of pipe shall be done in a neat and workmanlike manner without damage to the pipe. Unless otherwise recommended by the manufacturer and authorized by the Contracting Officer, cutting shall be done with an approved type mechanical cutter. Wheel cutter shall be used when practicable. Copper tubing shall be cut square and all burrs shall be removed. Squeeze type mechanical cutters shall not be used for ductile iron.

3.1.2 Adjacent Facilities

3.1.2.1 Sewer Lines

Where the location of the water pipe is not clearly defined in dimensions on the drawings, the water pipe shall not be laid closer horizontally than 10 feet from a sewer except where the bottom of the water pipe will be at least 12 inches above the top of the sewer pipe, in which case the water pipe shall not be laid closer horizontally than 6 feet from the sewer. Where water lines cross under gravity-flow sewer lines, the sewer pipe, for a distance of at least 10 feet each side of the crossing, shall be fully encased in concrete or shall be made of pressure pipe with no joint located within 3 feet horizontally of the crossing. Water lines shall in all cases cross above sewage force mains or inverted siphons and shall be not less than 2 feet above the sewer main. Joints in the sewer main, closer horizontally than 3 feet to the crossing, shall be encased in concrete.

3.1.2.2 Water Lines

Water lines shall not be laid in the same trench with sewer lines, gas lines, fuel lines, or electric wiring.

3.1.2.3 Copper Tubing Lines

Copper tubing shall not be installed in the same trench with ferrous piping materials.

3.1.2.4 Nonferrous Metallic Pipe

Where nonferrous metallic pipe, e.g. copper tubing, crosses any ferrous piping material, a minimum vertical separation of 12 inches shall be maintained between pipes.

3.1.3 Joint Deflection

3.1.3.1 Offset for Flexible Plastic Pipe

The maximum offset in alignment between adjacent pipe joints shall be as recommend by the manufacturer and approved by the Contracting Officer but shall not exceed 5 degrees.

3.1.4 Placing and Laying

Pipe and accessories shall be carefully lowered into the trench by means of derrick, ropes, belt slings, or other authorized equipment. Water-line materials shall not be dropped or dumped into the trench. Abrasion of the pipe coating shall be avoided. Except where necessary in making connections with other lines or as authorized by the Contracting Officer, pipe shall be laid with the bells facing in the direction of laying. The full length of each section of pipe shall rest solidly upon the pipe bed, with recesses excavated to accommodate bells, couplings, and joints. Pipe that has the grade or joint disturbed after laying shall be taken up and relaid. Pipe shall not be laid in water or when trench conditions are unsuitable for the work. Water shall be kept out of the trench until joints are complete. When work is not in progress, open ends of pipe, fittings, and valves shall be securely closed so that no trench water, earth, or other substance will enter the pipes or fittings. Where any part of the coating or lining is damaged, the repair shall be made by and at the Contractor's expense in a satisfactory manner. Pipe ends left for future connections shall be valved, plugged, or capped, and anchored, as shown.

3.1.4.1 Piping Connections

Where connections are made between new work and existing mains, the connections shall be made by using mechanical joints and specials and fittings to suit the actual conditions. When made under pressure, these connections shall be installed using standard methods as approved by the Contracting Officer. Connections to existing asbestos-cement pipe shall be made in accordance with ACPPA Work Practices.

3.1.4.2 Plastic Pipe Installation

PVC pipe shall be installed in accordance wiht AWWA M23.

3.1.5 Jointing

3.1.5.1 PVC Plastic Pipe Requirements

- a. Pipe less than 4 inch diameter: Threaded joints shall be made by wrapping the male threads with approved thread tape or applying an approved lubricant, then threading the joining members together. The

joint shall be tightened using strap wrenches to prevent damage to the pipe and/or fitting. To avoid excessive torque, joints shall be tightened no more than one thread past hand-tight. Preformed rubber-ring gaskets for elastomeric-gasket joints shall be made in accordance with ASTM F 477 and as specified. Pipe ends for push-on joints shall be beveled to facilitate assembly and marked to indicate when the pipe is fully seated. The gasket shall be prelubricated to prevent displacement. The gasket and ring groove in the bell or coupling shall match. The manufacturer of the pipe or fitting shall supply the elastomeric gasket. Couplings shall be provided with stops or centering rings to assure that the coupling is centered on the joint. Solvent cement joints shall use sockets conforming to ASTM D 2467. The solvent cement used shall be made in accordance with ASTM D 2564; the joint assembly shall be made in accordance with ASTM D 2855 and the manufacturer's specific recommendations.

b. Pipe 4 through 12 inch diameter: Joints shall be elastomeric gasket as specified in AWWA C900. Jointing procedure shall be as specified for pipe less than 4 inch diameter with configuration using elastomeric ring gasket.

3.1.5.2 Copper Tubing Requirements

Joints shall be made with flared fittings. The flared end tube shall be pulled tightly against the tapered part of the fitting by a nut which is part of the fitting, so there is metal-to-metal contact.

3.1.6 Installation of Service Lines

Service lines shall include the pipeline connecting building piping to water distribution lines to the connections with the building service at a point approximately 5 feet outside the building where such building service exists. Where building services are not installed, the Contractor shall terminate the service lines approximately 5 feet from the site of the proposed building at a point designated by the Contracting Officer. Such service lines shall be closed with plugs or caps. All service stops and valves shall be provided with service boxes. Service lines shall be constructed in accordance with the following requirements:

3.1.6.1 Service Lines 2 Inches and Smaller

Service lines 2 inches and smaller shall be connected to the main by a directly-tapped corporation stop or by a service clamp. A corporation stop and a copper gooseneck shall be provided with either type of connection. Maximum sizes for directly-tapped corporation stops and for outlets with service clamps shall be as in TABLE I. Where 2 or more gooseneck connections to the main are required for an individual service, such connections shall be made with standard branch connections. The total clear area of the branches shall be at least equal to the clear area of the service which they are to supply.

TABLE I. SIZE OF CORPORATION STOPS AND OUTLET

Pipe Size Inches	Corporation Stops, Inches For Ductile-Iron Pipe	Outlets w/Service Clamps, Inches Single & Double Strap
3	--	1
4	1	1
6	1-1/4	1-1/2
8	1-1/2	2
10	1-1/2	2
12 & larger	2	2

NOTE:

- a. Service lines 1-1/2 inches and smaller shall have a service stop.
- b. Service lines 2 inches in size shall have a gate valve.

3.1.7 Setting of Meters and Valves

3.1.7.1 Location of Meters

Meters and meter boxes shall be installed at the locations shown on the drawings. The meters shall be centered in the boxes to allow for reading and ease of removal or maintenance.

3.1.7.2 Location of Valves

After delivery, valves shall be drained to prevent freezing and shall have the interiors cleaned of all foreign matter before installation. Stuffing boxes shall be tightened and valves shall be fully opened and fully closed to ensure that all parts are in working condition. Valves and valve boxes shall be installed where shown or specified, and shall be set plumb. Valve boxes shall be centered on the valves. Boxes shall be installed over each outside gate valve unless otherwise shown. Where feasible, valves shall be located outside the area of roads, streets, and sidewalks. Earth fill shall be tamped around each valve box or pit to a distance of 4 feet on all sides of the box, or the undisturbed trench face if less than 4 feet.

3.1.8 Thrust Restraint

Plugs, caps, tees and bends deflecting 11.25 degrees or more, either vertically or horizontally, on waterlines 4 inches in diameter or larger, shall be provided with thrust restraints. Valves shall be securely anchored or shall be provided with thrust restraints to prevent movement. Thrust restraints shall be thrust blocks.

3.1.8.1 Thrust Blocks

Thrust blocking shall be concrete of a mix not leaner than: 1 cement, 2-1/2 sand, 5 gravel; and having a compressive strength of not less than 2,000 psi after 28 days. Blocking shall be placed between solid ground and the hydrant or fitting to be anchored. Unless otherwise indicated or directed, the base and thrust bearing sides of thrust blocks shall be poured directly against undisturbed earth. The sides of thrust blocks not subject to thrust may be poured against forms. The area of bearing shall be as shown or as directed. Blocking shall be placed so that the fitting joints will be accessible for repair. Steel rods and clamps, protected by galvanizing or by coating with bituminous paint, shall be used to anchor vertical down bends into gravity thrust blocks.

3.1.8.2 Restrained Joints

For ductile-iron pipe, restrained joints shall be designed by the Contractor or the pipe manufacturer in accordance with DIPRA-Restraint Design.

3.1.9 Pipe Encasement

Steel pipe casing shall be installed around water pipe where shown. Steel pipe casing shall materials and installation shall be as specified in SECTION 02531: SANITARY SEWERS.

3.1.10 Insulation

Watermain shall be insulated as shown at all watermain offsets.

3.2 HYDROSTATIC TESTS

Where any section of a water line is provided with concrete thrust blocking for fittings or hydrants, the hydrostatic tests shall not be made until at least 5 days after installation of the concrete thrust blocking, unless otherwise approved.

3.2.1 Pressure Test

After the pipe is laid, the joints completed, and the trench partially backfilled leaving the joints exposed for examination, the newly laid piping or any valved section of piping shall, unless otherwise specified, be subjected for 1 hour to a hydrostatic pressure test of 200 psi. Each valve shall be opened and closed several times during the test. Exposed pipe, joints, fittings, and valves shall be carefully examined during the partially open trench test. Joints showing visible leakage shall be replaced or remade as necessary. Cracked or defective pipe, joints, fittings, hydrants and valves discovered in consequence of this pressure test shall be removed and replaced with sound material, and the test shall be repeated until the test results are satisfactory. The requirement for the joints to remain exposed for the hydrostatic tests may be waived by the Contracting Officer when one or more of the following conditions is encountered:

- a. Wet or unstable soil conditions in the trench.
- b. Compliance would require maintaining barricades and walkways around and across an open trench in a heavily used area that would require continuous surveillance to assure safe conditions.
- c. Maintaining the trench in an open condition would delay completion of the project.

The Contractor may request a waiver, setting forth in writing the reasons for the request and stating the alternative procedure proposed to comply with the required hydrostatic tests. Backfill placed prior to the tests shall be placed in accordance with the requirements of Section 02316 EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS.

3.2.2 Leakage Test

Leakage test shall be conducted after the pressure tests have been satisfactorily completed. The duration of each leakage test shall be at least 2 hours, and during the test the water line shall be subjected to not less than 200 psi pressure. Water supply lines designated on the drawings shall be subjected to a pressure equal to 200 psi. Leakage is defined as the quantity of water to be supplied into the newly laid pipe, or any valved or approved section, necessary to maintain pressure within 5 psi of the specified leakage test pressure after the pipe has been filled with water and the air expelled. Piping installation will not be accepted if leakage exceeds the allowable leakage which is determined by the following formula:

$$L = 0.0001351ND(P \text{ raised to } 0.5 \text{ power})$$

L = Allowable leakage in gallons per hour

N = Number of joints in the length of pipeline tested

D = Nominal diameter of the pipe in inches

P = Average test pressure during the leakage test, in psi gauge

Should any test of pipe disclose leakage greater than that calculated by the above formula, the defective joints shall be located and repaired until the leakage is within the specified allowance, without additional cost to the Government.

3.2.3 Time for Making Test

Except for joint material setting or where concrete thrust blocks necessitate a 5-day delay, pipelines jointed with rubber gaskets, mechanical or push-on joints, or couplings may be subjected to hydrostatic pressure, inspected, and tested for leakage at any time after partial completion of backfill. Cement-mortar lined pipe may be filled with water as recommended by the manufacturer before being subjected to the pressure test and subsequent leakage test.

3.2.4 Concurrent Hydrostatic Tests

The Contractor may elect to conduct the hydrostatic tests using either or both of the following procedures. Regardless of the sequence of tests employed, the results of pressure tests, leakage tests, and disinfection shall be as specified. Replacement, repair or retesting required shall be accomplished by the Contractor at no additional cost to the Government.

- a. Pressure test and leakage test may be conducted concurrently.
- b. Hydrostatic tests and disinfection may be conducted concurrently, using the water treated for disinfection to accomplish the hydrostatic tests. If water is lost when treated for disinfection and air is admitted to the unit being tested, or if any repair procedure results in contamination of the unit, disinfection shall be reaccomplished.

3.3 BACTERIAL DISINFECTION

3.3.1 Bacteriological Disinfection

Before acceptance of potable water operation, each unit of completed waterline shall be disinfected as prescribed by AWWA C651. After pressure tests have been made, the unit to be disinfected shall be thoroughly flushed with water until all entrained dirt and mud have been removed before introducing the chlorinating material. The chlorinating material shall be either liquid chlorine, calcium hypochlorite, or sodium hypochlorite, conforming to paragraph MISCELLANEOUS ITEMS. The chlorinating material shall provide a dosage of not less than 50 ppm and shall be introduced into the water lines in an approved manner. Polyvinyl chloride (PVC) pipelines shall be chlorinated using only the above specified chlorinating material in solution. The agent shall not be introduced into the line in a dry solid state. The treated water shall be retained in the pipe long enough to destroy all non-spore forming bacteria.

Except where a shorter period is approved, the retention time shall be at least 24 hours and shall produce not less than 25 ppm of free chlorine residual throughout the line at the end of the retention period. Valves on the lines being disinfected shall be opened and closed several times during the contact period. The line shall then be flushed with clean water until the residual chlorine is reduced to less than 1.0 ppm. Personnel from the Contractor's commercial laboratory shall take at least 3 water samples on each line from different points, approved by the Contracting Officer, in proper sterilized containers and perform a bacterial examination in accordance with state approved methods. The commercial laboratory shall be certified by the state's approving authority for examination of potable water. The disinfection shall be repeated until tests indicate the absence of pollution for at least 2 full days. The unit will not be accepted until satisfactory bacteriological results have been obtained.

3.4 CLEANUP

Upon completion of the installation of water lines, and appurtenances, all debris and surplus materials resulting from the work shall be removed.

-- End of Section --

SECTION TABLE OF CONTENTS

DIVISION 02 - SITE WORK

SECTION 02531

SANITARY SEWERS

04/01

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 GENERAL REQUIREMENTS
- 1.3 SUBMITTALS

PART 2 PRODUCTS

- 2.1 PIPE
 - 2.1.1 Plastic Pipe
 - 2.1.1.1 PVC Pipe
 - 2.1.1.2 Ductile Iron Pipe
- 2.2 REQUIREMENTS FOR FITTINGS
- 2.3 JOINTS
 - 2.3.1 Plastic Pipe Jointing
 - 2.3.2 Ductile Iron Pipe
- 2.4 BRANCH CONNECTIONS
- 2.5 FRAMES AND COVERS
- 2.6 STEEL LADDER
- 2.7 MANHOLE STEPS
- 2.8 CEMENT MORTAR
 - 2.8.1 Portland Cement
 - 2.8.2 Portland Cement Concrete
- 2.9 STRUCTURES
 - 2.9.1 Precast Reinforced Concrete Manhole Sections
 - 2.9.2 Flexible Watertight Joints
 - 2.9.3 Chimney Seal
 - 2.9.3.1 External Rubber Seal
 - 2.9.3.2 Compression Bands
- 2.10 Casing Pipe
- 2.11 VALVES
 - 2.11.1 Gate Valves
- 2.12 INSULATION

PART 3 EXECUTION

- 3.1 INSTALLATION
 - 3.1.1 Adjacent Facilities
 - 3.1.1.1 Water Lines
 - 3.1.1.2 Structural Foundations
 - 3.1.2 Pipe Laying

- 3.1.2.1 Trenches
- 3.1.2.2 Backfill
- 3.1.2.3 Width of Trench
- 3.1.2.4 Jointing
- 3.1.2.5 Handling and Storage
- 3.1.3 Casing Pipe
- 3.1.4 PE Pipe Encasement
- 3.1.5 Leakage Tests
- 3.1.6 Test for Deflection
- 3.2 INSTALLATION OF WYE BRANCHES
- 3.3 MANHOLE DETAILS
 - 3.3.1 General Requirements
 - 3.3.2 Steel Ladder Anchorage
 - 3.3.3 Jointing, Plastering and Sealing
 - 3.3.4 Setting of Frames and Covers
 - 3.3.5 Flexible Watertight Joints
- 3.4 CONNECTING TO EXISTING MANHOLES
- 3.5 BUILDING CONNECTIONS
- 3.6 CLEANOUTS AND OTHER APPURTENANCES
- 3.7 VALVES
- 3.8 INSULATION

-- End of Section Table of Contents --

SECTION 02531

SANITARY SEWERS

04/01

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS
(AASHTO)

AASHTO M 198	Joints for Circular Concrete Sewer and Culvert Pipe Using Flexible Watertight Joints
--------------	--

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 123	(1997a) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 240	(1997a) Specification for Heat Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels
ASTM C 94	(1998) Ready-Mixed Concrete
ASTM C 150	(1997) Portland Cement
ASTM C 270	(1997ael) Mortar for Unit Masonry
ASTM C 425	(1998) Compression Joints for Vitrified Clay Pipe and Fittings
ASTM C 443	(1998) Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets
ASTM C 478	Specification for Precast Reinforced Concrete Manhole Sections
ASTM C 923	(1996) Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes, and Laterals
ASTM C 972	(1995) Compression-Recovery of Tape Sealant

ASTM D 412	(1998a) Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers - Tension
ASTM D 624	(1991; R 1998) Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers
ASTM D 1784	(1999) Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
ASTM D 2842	Test Method for Water Absorption of Rigid Cellular Plastics
ASTM D 3034	(1998) Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings
ASTM D 3139	(1996a) Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
ASTM D 3212	(1996a) Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
ASTM F 402	(1993) Safe Handling of Solvent Cements, Primers, and Cleaners Used for Joining Thermoplastic Pipe and Fittings
ASTM F 477	(1996a) Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe
ASTM F 593	(1995) Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs
ASTM F 594	Specification for Stainless Steel Nuts
ASTM F 794	(1997) Poly(Vinyl Chloride) (PVC) Profile Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter
ASTM F 949	(1996a) Poly(Vinyl Chloride) (PVC) Corrugated Sewer Pipe with a Smooth Interior and Fittings

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C110	(1993) Ductile-Iron and Gray-Iron fittings, 3 in. through 48 in. for Water and Other Liquids
AWWA C111	(1995) Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings

AWWA C151	(1996) Ductile-Iron Pipe, Centrifugally Cast, for Water or Other Liquids
AWWA C500	(1993; C500a) Metal-Sealed Gate Valves for Water Supply Service
AWWA C900	(1989; C900a) Polyvinyl Chloride (PVC) Pressure Pipe, 4 In. through 12 In., for Water Distribution

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 49	(1994) Hazardous Chemicals Data
NFPA 325-1	(1994) Fire Hazard Properties of Flammable Liquids, Gases, and Volatile Solids
NFPA 704	(1996) Identification of the Fire Hazards of Materials for Emergency Response

UNI-BELL PVC PIPE ASSOCIATION (UBPPA)

UBPPA UNI-B-6	(1990) Recommended Practice for the Low-Pressure Air Testing of Installed Sewer Pipe
UBPPA UNI-B-9	(1990; Addenda 1994) Recommended Performance Specification for Polyvinyl Chloride (PVC) Profile Wall Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter (Nominal Pipe Sizes 4-48 inch)

1.2 GENERAL REQUIREMENTS

The construction required herein shall include appurtenant structures and building sewers to points of connection with the building drains 5 feet outside the building to which the sewer system is to be connected. The Contractor shall replace damaged material and redo unacceptable work at no additional cost to the Government. Excavation and backfilling is specified in Section 02316 EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS. Backfilling shall be accomplished after inspection by the Contracting Officer. Force mains are specified in Section 02532: FORCE MAINS.

1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having a "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-13 Certificates

Portland Cement; GA.

Certificates of compliance stating the type of cement used in manufacture of concrete pipe, fittings and precast manholes.

PART 2 PRODUCTS

2.1 PIPE

Pipe shall conform to the respective specifications and other requirements specified below.

2.1.1 Plastic Pipe

2.1.1.1 PVC Pipe

PVC pipe and fittings: AWWA C900, Class 150 with push-on joints.

2.1.1.2 Ductile Iron Pipe

a. Ductile Iron Pipe: AWWA C151, working pressure not less than 150 psi.

b. Fittings, Mechanical: AWWA C110, rated for 150 psi.

2.2 REQUIREMENTS FOR FITTINGS

Fittings shall be compatible with the pipe supplied and shall have a strength not less than that of the pipe. Fittings shall conform to the respective specifications and other requirements specified below.

2.3 JOINTS

Joints connecting pipe of differing materials shall be mechanical joint or as recommended by the manufacturer subject to the approval of the Contracting Officer.

2.3.1 Plastic Pipe Jointing

Push on joints: ASTM D 3139, with ASTM F 477 gaskets.

2.3.2 Ductile Iron Pipe

Mechanical joints: AWWA C111 as modified by AWWA C151.

2.4 BRANCH CONNECTIONS

Branch connections shall be made by use of regular fittings or solvent cemented saddles as approved. Saddles for PVC pipe shall conform to Table 4 of ASTM D 3034.

2.5 FRAMES AND COVERS

Frames and covers shall be cast iron or ductile iron. Cast iron frames and covers shall be as indicated or shall be of type suitable for the application, circular, without vent holes. The frames and covers shall have a combined weight of not less than 400 pounds. The word "Sewer" shall be stamped or cast into covers so that it is plainly visible. All covers and frames shall be capable of withstanding and HS20 wheel load.

2.6 STEEL LADDER

A steel ladder shall be provided where the depth of a manhole is 12 feet or greater. Ladders shall be as shown. Ladders and inserts shall be galvanized after fabrication in conformance with ASTM A 123.

2.7 MANHOLE STEPS

Manhole steps shall be provided for manholes less than 12 feet in depth. Manhole steps shall be a minimum of 12 inches wide with rungs spaced 12 inches apart. Manhole steps shall be cast aluminum or polypropylene-coated steel.

2.8 CEMENT MORTAR

Cement mortar shall conform to ASTM C 270, Type M with Type II cement.

2.8.1 Portland Cement

Portland cement shall conform to ASTM C 150, Type II for concrete in manholes.

2.8.2 Portland Cement Concrete

Portland cement concrete shall conform to ASTM C 94, compressive strength of 4000 psi at 28 days. Concrete in place shall be protected from freezing and moisture loss for 7 days.

2.9 STRUCTURES

2.9.1 Precast Reinforced Concrete Manhole Sections

Precast reinforced concrete manhole sections shall conform to ASTM C 478, except that portland cement shall be as specified herein. Joints between sections shall be flexible watertight joints.

2.9.2 Flexible Watertight Joints

Materials: Flexible watertight joints shall be made with plastic or rubber-type gaskets for concrete pipe. The design of joints and the physical requirements for plastic gaskets shall conform to AASHTO M 198, and rubber-type gaskets shall conform to ASTM C 443. Factory-fabricated resilient joint materials shall conform to ASTM C 425. Gaskets shall have not more than one factory-fabricated splice, except that two factory-fabricated splices of the rubber-type gasket are permitted if the

nominal diameter of the pipe being gasketed exceeds 54 inches.

2.9.3 Chimney Seal

The manhole frame and chimney joint area of sanitary sewer manhole structures shall be sealed with an external flexible rubber seal as shown. The chimney seal shall consist of an external flexible rubber seal and compression bands.

2.9.3.1 External Rubber Seal

The flexible rubber sleeve and extension shall be extruded from a high grade rubber compound conforming to the applicable requirements of ASTM C 923, with a minimum 1,500 psi tensile strength, maximum 18% compression set and a hardness (durometer) of 48 ± 5 .

The sleeve shall be corrugated, with a minimum thickness of 3/16 inches and shall be available in unexpanded vertical heights of 6 and 9 inches, each capable of a vertical expansion of not less than 2 inches when installed. The top section of the sleeve shall contain multiple sealing fins and be designed to extend both over and under the manhole base flange, thereby allowing it to be mechanically locked in place. The bottom section of the sleeve shall contain an integrally formed compression band recess and multiple sealing fins.

The extension shall have a minimum thickness of 3/16 inches. The top portion of the extension shall be shaped to fit into the bottom band recess of the sleeve and have its own integrally formed band recess, which is located such that when assembled the recess is centered over that of the sleeve. The bottom section of the extension shall contain an integrally formed compression band recess and multiple sealing fins.

Any splice used to fabricate the sleeve and extension shall be hot vulcanized and have a strength such that the sleeve shall withstand a 180 degree bend with no visible separation.

2.9.3.2 Compression Bands

Expansion bands used to compress the rubber seal against the manhole frame shall be minimum 16 gauge stainless steel conforming to ASTM A 240, Type 304, with a minimum width of 1 inch. The top compression band shall have a shape and width sufficient to mechanically lock the sleeve and frame together, when tightened.

The tightening mechanism on both bands shall have the capacity to develop the pressures necessary to make a watertight seal and shall have a minimum adjustment range of 2 diameter inches. Screws, bolts, nuts, and other hardware used on the bands shall be stainless steel conforming to ASTM F 593 and ASTM F 594, Type 304.

2.10 Casing Pipe

Casing pipe shall be welded steel pipe, new material, with a minimum yield of 35,000 psi. The minimum wall thickness shall be 0.250 inches for casing

pipe with outside diameter 24" or less, shall be 0.375 inches for casing pipe with outside diameter greater than 24" and less than or equal to 30", and shall be 0.5 inches for casing pipe 36" in diameter or larger. A minimum clearance of at least 2 inches between the inner wall of the casing pipe and the maximum outside diameter of the cased pipe and joints shall be provided. Sand shall be placed in the void between the inner wall of the casing pipe and the cased pipe. A minimum of 1 foot of grout shall be placed in the void between the inner wall of the casing pipe and the cased pipe at the ends of the casing pipe after placement of sand. Steel casing pipe shall be encased in polyethylene as specified in Paragraph: PE Pipe Encasement.

2.11 VALVES

2.11.1 Gate Valves

Gate valves shall be designed for a working pressure of not less than 150 psi. Valve connections shall be as required for the piping in which they are installed. Valves shall have a clear waterway equal to the full nominal diameter of the valve, and shall be opened by turning counterclockwise. The operating nut or wheel shall have an arrow, cast in the metal, indicating the direction of the opening.

- a. Valves 3 inches and larger shall be iron body, bronze mounted, and shall conform to AWWA C500. Flanges shall not be buried. An approved pit shall be provided for all flanged connections.

2.12 INSULATION

Insulation shall be rigid, extruded polystyrene board with minimum thermal resistance (R) of 5.0. Board size shall be 48-inch x 96-inch. Edges shall be square. Compressive strength shall be minimum 25 psi. Water absorption shall be maximum 0.1 percent in accordance with ASTM D 2842. Minimum thickness of individual boards shall be 1-inch.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Adjacent Facilities

3.1.1.1 Water Lines

Where the location of the sewer is not clearly defined by dimensions on the drawings, the sewer shall not be closer horizontally than 10 feet to a water-supply main or service line, except that where the bottom of the water pipe will be at least 12 inches above the top of the sewer pipe, the horizontal spacing may be a minimum of 6 feet. Where gravity-flow sewers cross above water lines, the sewer pipe for a distance of 10 feet on each side of the crossing shall be fully encased in concrete or shall be acceptable pressure pipe with no joint closer horizontally than 3 feet to the crossing. The thickness of the concrete encasement including that at the pipe joints shall be not less than 4 inches.

3.1.1.2 Structural Foundations

Where sewer pipe is to be installed within 3 feet of an existing or proposed building or structural foundation, the sewer pipe shall be sleeved as specified above. A minimum clearance of at least 2 inches between the inner wall of the sleeve and the maximum outside diameter of the sleeved pipe and joints shall be provided. Sand bedding shall be placed between the pipe and sleeve. Contractor shall ensure there is no damage to these structures, and no settlement or movement of foundations or footing.

3.1.2 Pipe Laying

- a. Pipe shall be protected during handling against impact shocks and free fall; the pipe interior shall be free of extraneous material.
- b. Pipe laying shall proceed upgrade with the spigot ends of bell-and-spigot pipe and tongue ends of tongue-and-groove pipe pointing in the direction of the flow. Each pipe shall be laid accurately to the line and grade shown on the drawings. Pipe shall be laid and centered so that the sewer has a uniform invert. As the work progresses, the interior of the sewer shall be cleared of all superfluous materials.
- c. Before making pipe joints, all surfaces of the portions of the pipe to be joined shall be clean and dry. Lubricants, primers, and adhesives shall be used as recommended by the pipe manufacturer. The joints shall then be placed, fitted, joined, and adjusted to obtain the degree of water tightness required.
- d. Installations of solvent weld joint pipe, using PVC pipe and fittings shall be in accordance with ASTM F 402. The Contractor shall ensure adequate trench ventilation and protection for workers installing the pipe.

3.1.2.1 Trenches

Trenches shall be kept free of water and as dry as possible during bedding, laying, and jointing and for as long a period as required. When work is not in progress, open ends of pipe and fittings shall be satisfactorily closed so that no trench water or other material will enter the pipe or fittings.

3.1.2.2 Backfill

As soon as possible after the joint is made, sufficient backfill material shall be placed along the pipe to prevent pipe movement off line or grade. Plastic pipe shall be completely covered to prevent damage from ultraviolet light.

3.1.2.3 Width of Trench

If the width of the trench at the top of the pipe exceeds that shown for any reason other than by direction, the Contractor shall install, at no

additional cost to the Government, concrete cradling, pipe encasement, or other bedding required to support the added load of the backfill.

3.1.2.4 Jointing

Joints between different pipe materials shall be made as specified, using approved jointing materials.

3.1.2.5 Handling and Storage

Pipe, fittings and joint material shall be handled and stored in accordance with the manufacturer's recommendations. Storage facilities for plastic pipe, fittings, joint materials and solvents shall be classified and marked in accordance with NFPA 704, with classification as indicated in NFPA 49 and NFPA 325-1.

3.1.3 Casing Pipe

Steel casing pipe shall be provided for sanitary sewers shown.

3.1.4 PE Pipe Encasement

Steel and ductile iron pipe and casing pipe shall be encased with 8 mil thick polyethylene in accordance with AWWA C105.

3.1.5 Leakage Tests

Sanitary sewer mains shall be tested for leakage by low pressure air testing, infiltration tests or exfiltration tests, as appropriate. Low pressure air testing for PVC pipe shall be as prescribed in UBPPA UNI-B-6. Prior to infiltration or exfiltration tests, the trench shall be backfilled up to at least the lower half of the pipe. If required, sufficient additional backfill shall be placed to prevent pipe movement during testing, leaving the joints uncovered to permit inspection. Visible leaks encountered shall be corrected regardless of leakage test results. When the water table is 2 feet or more above the top of the pipe at the upper end of the pipeline section to be tested, infiltration shall be measured using a suitable weir or other device acceptable to the Contracting Officer. When the Contracting Officer determines that infiltration cannot be properly tested, an exfiltration test shall be made by filling the line to be tested with water so that a head of at least 2 feet is provided above both the water table and the top of the pipe at the upper end of the pipeline to be tested. The filled line shall be allowed to stand until the pipe has reached its maximum absorption, but not less than 4 hours. After absorption, the head shall be re-established. The amount of water required to maintain this water level during a 2-hour test period shall be measured. Leakage as measured by either the infiltration test or exfiltration test shall not exceed 25 gal per inch diameter per mile of pipeline per day. When leakage exceeds the maximum amount specified, satisfactory correction shall be made and retesting accomplished. Testing, correction, and retesting shall be made at no additional cost to the Government.

3.1.6 Test for Deflection

When flexible pipe is used, a deflection test shall be made on the entire length of the installed pipeline not less than 30 days after the completion of all work including the leakage test, backfill, and placement of any fill, grading, paving, concrete, or superimposed loads. Deflection shall be determined by use of a deflection device or by use of a spherical, spheroidal, or elliptical ball, a cylinder, or circular sections fused to a common shaft. The ball, cylinder, or circular sections shall have a diameter, or minor diameter as applicable, of 92.5 percent of the inside diameter of the pipe. A tolerance of plus 0.5 percent will be permitted. The ball, cylinder, or circular sections shall be of a homogeneous material throughout, shall have a density greater than 1.0 as related to water at 39.2 degrees F, and shall have a surface brinell hardness of not less than 150. The device shall be center bored and through bolted with a 1/4 inch minimum diameter steel shaft having a yield strength of 70,000 psi or more, with eyes at each end for attaching pulling cables. The eye shall be suitably backed with flange or heavy washer; a pull exerted on the opposite end of the shaft shall produce compression throughout the remote end of the ball, cylinder or circular section. Circular sections shall be spaced so that the distance from the external faces of the front and back sections shall equal or exceed the diameter of the circular section. Failure of the ball, cylinder, or circular section to pass freely through a pipe run, either by being pulled through or by being flushed through with water, shall be cause for rejection of that run. When a deflection device is used for the test in lieu of the ball, cylinder, or circular sections described, such device shall be approved prior to use. The device shall be sensitive to 1.0 percent of the diameter of the pipe being measured and shall be accurate to 1.0 percent of the indicated dimension. Installed pipe showing deflections greater than 7.5 percent of the normal diameter of the pipe shall be retested by a run from the opposite direction. If the retest also fails, the suspect pipe shall be replaced at no cost to the Government.

3.2 INSTALLATION OF WYE BRANCHES

Wye branches shall be installed where sewer connections are indicated or where directed. Cutting into piping for connections shall not be done except in special approved cases. When the connecting pipe cannot be adequately supported on undisturbed earth or tamped backfill, the pipe shall be encased in concrete backfill or supported on a concrete cradle as directed. Concrete required because of conditions resulting from faulty construction methods or negligence by the Contractor shall be installed at no additional cost to the Government. The installation of wye branches in an existing sewer shall be made by a method which does not damage the integrity of the existing sewer. One acceptable method consists of removing one pipe section, breaking off the upper half of the bell of the next lower section and half of the running bell of wye section. After placing the new section, it shall be rotated so that the broken half of the bell will be at the bottom. The two joints shall then be made with joint packing and cement mortar.

3.3 MANHOLE DETAILS

3.3.1 General Requirements

Manholes shall be constructed of precast concrete manhole sections. The

invert channels shall be smooth and semicircular in shape conforming to the inside of the adjacent sewer section. Changes in direction of flow shall be made with a smooth curve of as large a radius as the size of the manhole will permit. Changes in size and grade of the channels shall be made gradually and evenly. The invert channels shall be formed directly in the concrete of the manhole base, or shall be built up with brick and mortar, or shall be half tile laid in concrete, or shall be constructed by laying full section sewer pipe through the manhole and breaking out the top half after the surrounding concrete has hardened. Pipe connections shall be made to manhole using water stops, standard O-ring joints, special manhole coupling, or shall be made in accordance with the manufacturer's recommendation. The Contractor's proposed method of connection, list of materials selected, and specials required, shall be approved prior to installation. The floor of the manhole outside the channels shall be smooth and shall slope toward the channels not less than 1 inch per foot nor more than 2 inches per foot. Free drop inside the manholes shall not exceed 18 inches, measured from the invert of the inlet pipe to the top of the floor of the manhole outside the channels; drop manholes shall be constructed whenever the free drop would otherwise be greater than 1 foot 6 inches.

3.3.2 Steel Ladder Anchorage

Ladder shall be adequately anchored to the wall by means of steel inserts spaced not more than 6 feet apart vertically, and shall be installed to provide at least 6 inches of space between the wall and the rungs. The wall along the line of the ladder shall be vertical for its entire length.

3.3.3 Jointing, Plastering and Sealing

Mortar joints shall be completely filled and shall be smooth and free from surplus mortar on the inside of the manhole. Mortar and mastic joints between precast rings shall be full-bedded in jointing compound and shall be smoothed to a uniform surface on both the interior and exterior of the manhole. Installation of rubber gasket joints between precast rings shall be in accordance with the recommendations of the manufacturer. Precast rings may also be sealed by the use of extruded rolls of rubber with mastic adhesive on one side.

3.3.4 Setting of Frames and Covers

Unless otherwise indicated, tops of frames and covers shall be set flush with finished grade in paved areas or 2 inches higher than finished grade in unpaved areas. Frame and cover assemblies shall be sealed to manhole sections using external preformed rubber joint seals that meet the requirements of ASTM D 412 and ASTM D 624, or other methods specified in paragraph Jointing, Plastering and Sealing, unless otherwise specified.

3.3.5 Flexible Watertight Joints

Gaskets and jointing materials shall be as recommended by the particular manufacturer in regard to use of lubricants, cements, adhesives, and other special installation requirements. Surfaces to receive lubricants, cements, or adhesives shall be clean and dry. Gaskets and jointing materials shall be

affixed to the pipe not more than 24 hours prior to the installation of the pipe, and shall be protected from the sun, blowing dust, and other deleterious agents at all times. Gaskets and jointing materials shall be inspected before installing the pipe; any loose or improperly affixed gaskets and jointing materials shall be removed and replaced. The pipe shall be aligned with the previously installed pipe, and the joint pushed home. If while the joint is being made the gasket becomes visibly dislocated, the pipe shall be removed and the joint remade.

3.4 CONNECTING TO EXISTING MANHOLES

Pipe connections to existing manholes shall be made so that finish work will conform as nearly as practicable to the applicable requirements specified for new manholes, including all necessary concrete work, cutting, and shaping. The connection shall be centered on the manhole. Holes for the new pipe shall be of sufficient diameter to allow packing cement mortar around the entire periphery of the pipe but no larger than 1.5 times the diameter of the pipe. Cutting the manhole shall be done in a manner that will cause the least damage to the walls.

3.5 BUILDING CONNECTIONS

Building connections shall include the lines to and connection with the building waste drainage piping at a point approximately 5 feet outside the building, unless otherwise indicated. Where building drain piping is not installed, the Contractor shall terminate the building connections approximately 5 feet from the site of the building at a point and in a manner designated.

3.6 CLEANOUTS AND OTHER APPURTENANCES

Cleanouts and other appurtenances shall be installed where shown on the drawings or as directed by the Contracting Officer, and shall conform to the detail of the drawings.

3.7 VALVES

Gate valves shall be installed where valves are indicated.

3.8 INSULATION

Insulation shall be installed where shown. Joints of insulation shall be staggered.

-- End of Section --

SECTION TABLE OF CONTENTS

DIVISION 02 - SITE WORK

SECTION 02532

FORCEMAINS

04/01

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 SUBMITTALS
- 1.3 DELIVERY AND STORAGE

PART 2 PRODUCTS

- 2.1 PIPE AND FITTINGS
 - 2.1.1 Plastic Pipe
 - 2.1.1.1 PVC Pipe
 - 2.1.2 Ductile Iron Pipe
- 2.2 JOINTS
 - 2.2.1 PVC Piping
 - 2.2.2 Ductile Iron Pipe
 - 2.2.2.1 Ductile Iron Pipe
 - 2.2.2.2 River Crossing Pipe
- 2.3 VALVES
 - 2.3.1 Gate Valves
 - 2.3.2 Check Valves
 - 2.3.3 Plug Valves
 - 2.3.4 Pinch Valves
 - 2.3.5 Air Release Valves
- 2.4 VALVE BOXES
- 2.5 VALVE VAULTS
- 2.6 MISCELLANEOUS MATERIALS
 - 2.6.1 Pipe Coatings and Linings
 - 2.6.2 Joint Lubricants
 - 2.6.3 Bolts, Nuts and Glands
 - 2.6.4 Joint Compound
 - 2.6.5 Joint Tape
 - 2.6.6 Bond Wire

PART 3 EXECUTION

- 3.1 INSTALLATION
 - 3.1.1 Forcemain Bypass and Relocation Plan
 - 3.1.1.1 Reach 2 Forcemain
 - 3.1.1.2 Reach 3 Forcemain
 - 3.1.2 Adjacent Facilities
 - 3.1.3 Cutting

- 3.1.4 Laying
- 3.1.5 Jointing
 - 3.1.5.1 Joints for PVC Pipe
 - 3.1.5.2 Joints for Ductile Iron Pipe
- 3.1.6 Coating and Lining
- 3.1.7 Pipe Encasement
 - 3.1.7.1 Casing Pipe
- 3.1.8 Installation of Valves
- 3.1.9 Installation of Valve Boxes
- 3.1.10 Installation of Valve Vaults
- 3.1.11 Drain Lines
- 3.1.12 Thrust Restraint
 - 3.1.12.1 Thrust Blocks
 - 3.1.12.2 Restrained Joints
- 3.1.13 Grout
- 3.1.14 Bonded Joints
- 3.2 HYDROSTATIC TESTS
 - 3.2.1 Pressure Test
 - 3.2.2 Leakage Test
 - 3.2.3 Retesting

-- End of Section Table of Contents --

SECTION 02532

FORCEMAINS

04/01

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN PETROLEUM INSTITUTE (API)

API Spec 6D (1994; Supple 1 June 1996; Supple 2 Dec 1997) Pipeline Valves (Gate, Plug, Ball, and Check Valves)

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 53 (1998) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless

ASTM C 478 (1997) Precast Reinforced Concrete Manhole Sections

ASTM C 478M (1997) Precast Reinforced Concrete Manhole Sections (Metric)

ASTM D 1784 (1999) Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds

ASTM D 1785 (1996b) Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120

ASTM D 2122 (1998) Determining Dimensions of Thermoplastic Pipe and Fittings

ASTM D 2241 (1996b) Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)

ASTM D 2464 (1996a) Threaded Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80

ASTM D 2564 (1996a) Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems

ASTM D 2657 (1997) Heat Fusion Joining Polyolefin Pipe

and Fittings

ASTM D 2774	(1994) Underground Installation of Thermoplastic Pressure Piping
ASTM D 2996	(1995) Filament-Wound "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe
ASTM D 3035	(1995) Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter
ASTM D 3139	(1998) Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
ASTM D 3308	(1997) PTFE Resin Skived Tape
ASTM D 3350	(1998a) Polyethylene Plastics Pipe and Fittings Materials
ASTM D 3754	(1996) "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Sewer and Industrial Pressure Pipe
ASTM D 4101	(1996a) Propylene Plastic Injection and Extrusion Materials
ASTM D 4161	(1996) "Fiberglass" (Glass-Fiber-Reinforced Thermosetting Resin) Pipe Joints Using Flexible Elastomeric Seals
ASTM F 477	(1996a) Elastomeric Seals (Gaskets) for Joining Plastic Pipe
ASTM F 1483	(1998) Oriented Poly(Vinyl Chloride), PVC0, Pressure Pipe

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B16.1	(1989) Cast Iron Pipe Flanges and Flanged Fittings
ASME B16.3	(1992) Malleable Iron Threaded Fittings

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C105	(1993) Polyethylene Encasement for Ductile-Iron Pipe Systems
AWWA C110	(1993) Ductile-Iron and Gray-Iron Fittings, 3 In. Through 48 In. (75 mm

	through 1200 mm), for Water and Other Liquids
AWWA C111	(1995) Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
AWWA C115	(1996) Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges
AWWA C151	(1996) Ductile-Iron Pipe, Centrifugally Cast, for Water or Other Liquids
AWWA C200	(1997) Steel Water Pipe - 6 In. (150 mm) and Larger
AWWA C203	(1997) Coal-Tar Protective Coatings and Linings for Steel Water Pipelines - Enamel and Tape - Hot-Applied
AWWA C207	(1994) Steel Pipe Flanges for Waterworks Service - Sizes 4 In. Through 144 In. (100 mm through 3,600 mm)
AWWA C208	(1996) Dimensions for Fabricated Steel Water Pipe Fittings
AWWA C210	(1997) Liquid-Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipelines
AWWA C300	(1997) Reinforced Concrete Pressure Pipe, Steel-Cylinder Type, for Water and Other Liquids
AWWA C301	(1992) Prestressed Concrete Pressure Pipe, Steel-Cylinder Type, for Water and Other Liquids
AWWA C303	(1995) Concrete Pressure Pipe, Bar-Wrapped, Steel-Cylinder Type
AWWA C500	(1993; C500a) Metal-Seated Gate Valves for Water Supply Service
AWWA C508	(1993; C508a) Swing-Check Valves for Waterworks Service, 2 In. (50 mm) Through 24 In. (600 mm) NPS
AWWA C600	(1993) Installation of Ductile-Iron Water Mains and Their Appurtenances
AWWA C900	(1989; C900a) Polyvinyl Chloride (PVC) Pressure Pipe, 4 In. Through 12 In., for Water Distribution

DUCTILE IRON PIPE RESEARCH ASSOCIATION (DIPRA)

DIPRA-Restraint Design (1997) Thrust Restraint Design for Ductile Iron Pipe

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-78 (1998) Cast Iron Plug Valves, Flanged and Threaded Ends

1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having a "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-04 Drawings

River Crossing Pipe Shop Drawings; GA

Catalog cuts of river crossing pipe and ductile iron fittings for the sanitary forcemain relocation in Reach 3, Station F48+00 and a plan and profile of the new forcemain shall be provided.

SD-08 Statements

Forcemain Bypass and Relocation Plan; GA

A plan of operations for relocating the forcemain without interrupting service shall be submitted. The submittal shall include plans, catalog cuts of valves and other materials, and design calculations.

SD-09 Reports

Hydrostatic Tests; FIO.

Copies of test results.

1.3 DELIVERY AND STORAGE

Pipe, fittings and accessories, and pipe coatings shall not be damaged during delivery, handling, and storage.

PART 2 PRODUCTS

2.1 PIPE AND FITTINGS

Piping for forcemains shall be PVC plastic, ductile iron, and ductile iron river crossing pipe as shown. Pipe shall conform to the respective specifications and other requirements specified below.

2.1.1 Plastic Pipe

2.1.1.1 PVC Pipe

- a. PVC Pipe and Fittings 4 inches Diameter and Larger: AWWA C900, Class 150 with push-on joints.

2.1.2 Ductile Iron Pipe

- a. Ductile Iron Pipe: AWWA C151, working pressure not less than 150 psi.
- b. River Crossing Pipe: AWWA C151, minimum thickness Class 54 with joints in compliance with applicable requirements of AWWA C110.
- c. Fittings, Mechanical: AWWA C110, rated for 150 psi.

2.2 JOINTS

Joints connecting pipe of differing materials shall be mechanical joint or as recommended by the manufacturer, subject to the approval of the Contracting Officer.

2.2.1 PVC Piping

- a. Screw Joint Fittings: ASTM D 2464, Schedule 80.
- b. Push-On Joint Fittings: ASTM D 3139, with ASTM F 477 gaskets.
- c. Solvent Cement: ASTM D 2564.
- d. Couplings for use with plain end pipe shall have centering rings or stops to ensure the coupling is centered on the joint.

2.2.2 Ductile Iron Pipe

2.2.2.1 Ductile Iron Pipe

Mechanical joints: AWWA C111 as modified by AWWA C151.

2.2.2.2 River Crossing Pipe

Ductile iron river crossing pipe joints shall be a ball and socket design to meet high deflection and restrained joint requirements. The joint shall be boltless type using a bayonet style locking of the retainer over the bell.

2.3 VALVES

2.3.1 Gate Valves

Gate valves 3 inches and larger shall comply with AWWA C500. Valves for buried service shall be non-rising stem (NRS), 2 inch square nut operated with joints applicable to the pipe or installation. Buried valves shall be

furnished with extension stems comprising socket, extension stem and operating nut, and shall be of an appropriate length to bring operating nut to within 6 inches of grade. One 4 foot "T" handle valve wrench shall be furnished for each quantity of 6 buried valves. Gate valves that are exposed or installed inside shall be outside screw and yoke (OS&Y), handwheel operated with flange ends unless otherwise indicated. Gate valve operating nuts and handwheels shall have an arrow and the word "OPEN" cast in raised letters to indicate the direction of opening. The valve shall be opened by turning counterclockwise. Gate valves 14 inches and larger shall be equipped with gearing to reduce operating effort. Gate valves 14 inches and larger installed in horizontal lines in horizontal position with stems horizontal shall be equipped with bronze track, roller and scrapers to support the weight of the gate for its full length of travel. Gate valves 14 inches and larger installed in vertical pipe lines with stems horizontal shall be fitted with slides to assist the travel of the gate assembly.

2.3.2 Check Valves

Check valves shall permit free flow of sewage forward and provide a positive check against backflow. Check valves shall be designed for a minimum working pressure of 150 psi or as indicated. The body shall be iron. The manufacturer's name, initials, or trademark and also the size of the valve, working pressure, and direction of flow shall be directly cast on the body.

- a. Ball Check Valves shall be iron body, shall have flanged ends, and shall be the non-slam type. Flanges shall be the 125 pound type complying with ASME B16.1. Ball shall be stainless steel unless otherwise specified.
- b. Swing Check Valves shall comply with AWWA C508 and shall be iron body, bronze mounted, and shall have flanged ends. Flanges shall be the 125 pound type complying with ASME B16.1.

2.3.3 Plug Valves

Cast iron valves shall comply with MSS SP-78. Steel plug valves shall comply with API Spec 6D.

2.3.4 Pinch Valves

Pinch valves shall be double acting, jam-proof type with unobstructed streamlined flows and built-in operator. The body shall be iron with a non-rising handwheel. The sleeve shall be of pure gum rubber, neoprene, Buna N or hypalon as required for service. The valve shall have flanged ends. Flanges shall be of the 125 pound type complying with ASME B16.1.

2.3.5 Air Release Valves

Air release valves shall be designed to permit release of air from an empty pipe during filling and shall be capable of discharging accumulated air in the line while the line is in operation and under pressure. Valves shall be attached by means of threaded pipe connections. Valves shall be vented to the atmosphere.

- a. Manual Air Release Valves: Manual air release valves shall consist of a 3 inch gate valve and 3 inch ductile iron pipe and fittings. The valve shall be installed with its line of flow in the horizontal position.
- b. Automatic Air Release Valve: Automatic air release valves shall be of the compound lever type capable of withstanding operating pressures of 150 psi. The valves shall have a 1/2 inch outlet. The body and cover of the valve shall be of iron with a stainless steel float. All internal parts shall be stainless steel or bronze. The valve shall be specifically adapted for use with sewage. Each valve shall be complete with hose and blow-off valves to permit backflushing without dismantling the valve.

2.4 VALVE BOXES

Valve boxes shall be cast iron or concrete, except that concrete boxes may be installed only in locations not subject to vehicular traffic. Cast iron boxes shall be the extension type with slide type adjustment and with flared base. The minimum thickness of metal shall be 3/16 inch. The box length shall be adaptable, without full extension, to the depth of cover over the pipe at the valve locations. Concrete boxes shall be the standard product of a manufacturer of precast concrete equipment. The word "SEWER" shall be cast in the cover.

2.5 VALVE VAULTS

Valve vaults shall be precast concrete units conforming to ASTM C 478.

2.6 MISCELLANEOUS MATERIALS

Miscellaneous materials shall comply with the following requirements:

2.6.1 Pipe Coatings and Linings

- d. Polyethylene encasement for ductile iron: AWWA C105, minimum 8 mils thick.

2.6.2 Joint Lubricants

Joint lubricants shall be as recommended by the pipe manufacturer.

2.6.3 Bolts, Nuts and Glands

AWWA C111.

2.6.4 Joint Compound

A stiff mixture of graphite and oil or inert filler and oil.

2.6.5 Joint Tape

ASTM D 3308.

2.6.6 Bond Wire

Bond wire type RHW or USE, Size 1/0 AWG, neoprene jacketed copper conductor shaped to stand clear of the joint.

PART 3 EXECUTION

3.1 INSTALLATION

Pipe, pipe fittings, and appurtenances shall be installed at the locations indicated. Excavation, trenching, and backfilling shall be as specified in Section 02316 EXCAVATION, TRENCHING AND BACKFILLING FOR UTILITIES SYSTEMS.

3.1.1 Forcemain Bypass and Relocation Plan

Construction of forcemain shall be coordinated with the City of East Grand Forks Wastewater Department, Mr. Mark Kotbra, phone number (218) 773-1313. A plan for the forcemain bypass and relocation shall be submitted to the Contracting Officer for approval prior to conducting work on the forcemain.

3.1.1.1 Reach 2 Forcemain

The forcemain shown at the K12 pump station outlet in Reach 2 to be relocated can be taken out of service for the duration of the forcemain relocation. The amount of time that the forcemain is taken out of service shall be kept to a minimum. Once the forcemain is taken out of service, the relocation shall be completed in its entirety.

3.1.1.2 Reach 3 Forcemain

The forcemain shown near 3rd Avenue in Reach 3 to be relocated cannot be taken out of service during the relocation work. Flow shall be maintained for the duration of the relocation and project. The Contractor shall design and construct a bypass that will allow for the forcemain relocation and other project work to be performed without disruption of the sewer flow.

3.1.2 Adjacent Facilities

Installation of force mains and inverted siphons near adjacent facilities shall be as specified in Section 02531 SANITARY SEWERS.

3.1.3 Cutting

Pipe shall be cut in a neat manner with mechanical cutters. Wheel cutters shall be used where practicable. Sharp and rough edges shall be ground smooth and loose material removed from the pipe before laying.

3.1.4 Laying

Except where otherwise authorized, pipe shall be laid with bells facing the direction of laying. Before lowering and while suspended, the pipe shall be inspected for defects. Defective material shall be rejected. Pipe shall be laid in compliance with the following:

- a. Ductile Iron: AWWA C600.
- d. Polyvinyl Chloride: Manufacturer's instructions.

3.1.5 Jointing

3.1.5.1 Joints for PVC Pipe

- a. Threaded joints shall be made by wrapping the male threads with joint tape or by applying an approved thread lubricant, then threading the joining members together. The joint shall be tightened with strap wrenches which will not damage the pipe and fittings. The joint shall be tightened no more than 2 threads past hand-tight.
- b. Push-on joints: The ends of pipe for push-on joints shall be beveled to facilitate assembly. Pipe shall be marked to indicate when the pipe is fully seated. The gasket shall be lubricated to prevent displacement. The gasket shall remain in proper position in the bell or coupling while the joint is made.
- c. Solvent-weld joints shall comply with the manufacturer's instructions.

3.1.5.2 Joints for Ductile Iron Pipe

Installation of mechanical and push-on type joints shall comply with AWWA C600 and the manufacturer's instructions. Installation of flanged joints shall comply with manufacturer's instructions.

3.1.6 Coating and Lining

Field coating of non-galvanized steel pipe shall comply with AWWA C203. The applied materials shall be tested by means of a spark-type electrical device in compliance with AWWA C203. Flaws and holidays in the coating or lining of the pipe and the pipe joints shall be repaired; the repaired areas shall be at least equal in thickness to the minimum required for the pipe.

3.1.7 Pipe Encasement

When installed underground, ductile iron pipe shall be encased with 8 mil thick polyethylene in accordance with AWWA C105.

3.1.7.1 Casing Pipe

Steel casing pipe shall be provided for forcemain shown. Steel casing pipe materials and installation shall be as specified in SECTION 02531: SANITARY SEWERS.

3.1.8 Installation of Valves

Prior to installation, valves shall be cleaned of all foreign matter and

inspected for damage. Valves shall be fully opened and closed to ensure that all parts are properly operating. Valves shall be installed with the stem in the vertical position.

3.1.9 Installation of Valve Boxes

Valve boxes shall be installed over each outside gate valve, unless otherwise indicated. Valve boxes shall be centered over the valve. Fill shall be carefully tamped around each valve box to a distance of 4 feet on all sides or to undisturbed trench face, if less than 4 feet.

3.1.10 Installation of Valve Vaults

Valve vaults shall be installed as indicated.

3.1.11 Drain Lines

Drain lines shall be installed where indicated. The drain line shall consist of a tee in the main line with a 4 inch diameter branch, a 4 inch diameter elbow, and a 4 inch gate valve.

3.1.12 Thrust Restraint

Plugs, caps, tees and bends deflecting 11-1/4 degrees or more, either vertically or horizontally, shall be provided with thrust restraint. Valves shall be securely anchored or shall be provided with thrust restraints to prevent movement. Thrust restraints shall be either thrust blocks or, for ductile-iron pipes, restrained joints.

3.1.12.1 Thrust Blocks

Thrust blocking shall be concrete of a mix not leaner than: 1 cement, 2-1/2 sand, 5 gravel; and having a compressive strength of not less than 2000 psi after 28 days. Blocking shall be placed between solid ground and the fitting to be anchored. Unless otherwise indicated or directed, the base and thrust bearing sides of thrust blocks shall be poured directly against undisturbed earth. The sides of thrust blocks not subject to thrust may be poured against forms. The area of bearing shall be as shown or as directed. Blocking shall be placed so that the fitting joints will be accessible for repair. Steel rods and clamps, protected by galvanizing or by coating with bituminous paint, shall be used to anchor vertical down bends into gravity thrust blocks.

3.1.12.2 Restrained Joints

For ductile iron pipe, restrained joints shall be designed by the Contractor or the pipe manufacturer in accordance with DIPRA-Restraint Design.

3.1.13 Grout

Grout for exterior joint protection on concrete pipes shall be a mix of 1 part portland cement, 2 parts sand, and of sufficient liquid consistency to flow into the joint recess beneath the diaphragm. Grout for interior joint

protection shall be a mix of 1 part portland cement and 1 part sand. A polyurethane foam loop, impregnated with portland cement, may be substituted for grout for exterior joints.

3.1.14 Bonded Joints

Where indicated, a metallic bond shall be provided at each joint, including joints made with flexible couplings or rubber gaskets, of ferrous-metallic piping to effect continuous conductivity. The bond shall be of the thermal-weld type.

3.2 HYDROSTATIC TESTS

The pipeline shall be subjected to both a pressure test and a leakage test.

The method proposed for disposal of waste water from hydrostatic tests shall be approved by the Contracting Officer. Testing shall be the responsibility of the Contractor. The test may be witnessed by the Contracting Officer. The Contracting Officer shall be notified at least 7 days in advance of equipment tests. The final test report shall be delivered to the Contracting Officer within 30 days of the test.

3.2.1 Pressure Test

After the pipe has been installed, joints completed, thrust blocks have been in place for at least five days, and the trench has been partially backfilled, leaving the joints exposed for examination, the pipe shall be filled with water to expel all air. The pipeline shall be subjected to a test pressure of 100 psi or 150 percent of the working pressure, whichever is greater, for a period of at least one hour. Each valve shall be opened and closed several times during the test. The exposed pipe, joints, fitting, and valves shall be examined for leaks. Visible leaks shall be stopped or the defective pipe, fitting, joints, or valve shall be replaced.

3.2.2 Leakage Test

The leakage test may be conducted subsequent to or concurrently with the pressure test. The amount of water permitted as leakage for the line shall be placed in a sealed container attached to the supply side of the test pump. No other source of supply will be permitted to be applied to the pump or line under test. The water shall be pumped into the line by the test pump as required to maintain the specified test pressure as described for pressure test for a 2 hour period. Exhaustion of the supply or the inability to maintain the required pressure will be considered test failure. PE pipe can experience diametric expansion and pressure elongation during initial testing. The manufacturer shall be consulted prior to testing for special testing considerations. Allowable leakage shall be determined by the following I-P formula:

$L = NDP/K$ Where:

L = Allowable leakage in gallons per hour.

N = Number of joints in length of pipeline tested.

D = Nominal diameter of the pipe in inches.

P = Square root of the test pressure in psig.

K = 7400 for pipe materials.

At the conclusion of the test, the amount of water remaining in the container shall be measured and the results recorded in the test report.

3.2.3 Retesting

If any deficiencies are revealed during any test, such deficiencies shall be corrected and the tests shall be reconducted until the results of the tests are within specified allowances, without additional cost to the Government.

-- End of Section --

SECTION TABLE OF CONTENTS

DIVISION 02 - SITE WORK

SECTION 02620

SUBDRAINAGE SYSTEM

04/01

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 SUBMITTALS
- 1.3 DELIVER, STORAGE, AND HANDLING
 - 1.3.1 Delivery and Storage
 - 1.3.2 Handling

PART 2 PRODUCTS

- 2.1 PIPE FOR SUBDRAINS
 - 2.1.1 Plastic Pipe
 - 2.1.1.1 Corrugated Polyethylene (PE) Drain Tile and Fittings
 - 2.1.1.2 Pipe Perforations
- 2.2 GEOTEXTILE FABRIC
- 2.3 DRAINAGE STRUCTURES
- 2.4 SUBDRAIN FILTER AND BEDDING MATERIAL

PART 3 EXECUTION

- 3.1 EXCAVATION AND BEDDING FOR SUBDRAIN SYSTEMS
- 3.2 INSTALLATION OF FILTER FABRIC AND PIPE FOR SUBDRAINS
 - 3.2.1 Trench Lining and Overlaps
 - 3.2.2 Installation of Pipe for Subdrains
 - 3.2.2.1 Pipelaying
 - 3.2.2.2 Jointings
- 3.3 INSTALLATION OF FILTER MATERIAL AND BACKFILLING FOR SUBDRAINS

-- End of Section Table of Contents --

SECTION 02620

SUBDRAINAGE SYSTEM

04/01

PART 1 GENERAL

b1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM F 405 (1996) Corrugated Polyethylene (PE) Tubing and Fittings

MINNESOTA DEPARTMENT OF TRANSPORTATION (MNDOT) STANDARD SPECIFICATIONS FOR CONSTRUCTION 1995 EDITION WITH SUPPLEMENTS

MNDOT 3149 Granular Material

1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-13 Certificates

Geotextile Fabric; GA. Pipe for Subdrains; GA.

Certifications from the manufacturers attesting that materials meet specification requirements. Certificates are required for drain tile, fittings, pea gravel bedding, and geotextile fabric.

1.3 DELIVER, STORAGE, AND HANDLING

1.3.1 Delivery and Storage

Materials delivered to site shall be inspected for damage, unloaded, and stored with minimum handling. Materials shall not be stored directly on the ground. The inside of pipes and fittings shall be kept free of dirt and debris. During shipment and storage, filter fabric shall be wrapped in burlap or similar heavy duty protective covering. The storage area shall protect the fabric from mud, soil, dust, and debris. Filter fabric materials that are not to be installed immediately shall not be stored in direct sunlight. Plastic pipe shall be installed within 6 months from the

date of manufacture unless otherwise approved.

1.3.2 Handling

Materials shall be handled in such a manner as to insure delivery to the trench in sound undamaged condition. Pipe shall be carried and not dragged to the trench.

PART 2 PRODUCTS

2.1 PIPE FOR SUBDRAINS

Pipe for subdrains shall be of the types and sizes indicated.

2.1.1 Plastic Pipe

Plastic pipe shall contain ultraviolet inhibitor to provide protection from exposure to direct sunlight.

2.1.1.1 Corrugated Polyethylene (PE) Drain Tile and Fittings

Drain tile shall be in accordance with ASTM F 405. Fittings shall be manufacturer's standard type and shall conform to the indicated specification.

2.1.1.2 Pipe Perforations

Water inlet area shall be a minimum of 0.5 square inch per linear foot for perforated drain tile indicated. Manufacturer's standard perforated pipe which essentially meets these requirements may be substituted with prior approval of the Contracting Officer. Pipe with circular perforations will not be allowed.

- b. Slotted Perforations in Drain Tile: Circumferential slots shall be cleanly cut so as not to restrict the inflow of water and uniformly spaced along the length and circumference of the tubing. Width of slots shall not exceed 1/8 inch nor be less than 1/32 inch. The length of individual slots shall not exceed 1-1/4 inches on 3 inch diameter tubing, 10 percent of the tubing inside nominal circumference on 4 to 8 inch diameter tubing, and 2-1/2 inches on 10 inch diameter tubing. Rows of slots shall be symmetrically spaced so that they are fully contained in 2 quadrants of the pipe. Slots shall be centered in the valleys of the corrugations of profile wall pipe.

2.2 GEOTEXTILE FABRIC

Geotextile fabric shall be as specified in SECTION 02378: GEOTEXTILE FILTERS.

2.3 DRAINAGE STRUCTURES

Subdrainage system shall be connected to concrete drainage structures in accordance with SECTION 02630: STORM-DRAINAGE SYSTEM.

2.4 SUBDRAIN FILTER AND BEDDING MATERIAL

Pea gravel shall be used for subdrain filter and bedding material. Pea gravel for subdrainage system shall be fine filter aggregate in accordance with MNDOT 3149.

PART 3 EXECUTION

3.1 EXCAVATION AND BEDDING FOR SUBDRAIN SYSTEMS

Trenching and excavation, including the removal of rock and unstable material, shall be in accordance with Section 02316 EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS. Pea gravel material shall be placed in the trench as indicated or as required as replacement materials used in those areas where unstable materials were removed. Compaction of the bedding material shall be as specified for cohesionless material in Section 02316 EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS.

3.2 INSTALLATION OF FILTER FABRIC AND PIPE FOR SUBDRAINS

3.2.1 Trench Lining and Overlaps

Trenches to be lined with filter fabric shall be graded to obtain smooth side and bottom surfaces so that the fabric will not bridge cavities in the soil or be damaged by projecting rock. The fabric shall be laid flat but not stretched on the soil, and it shall be secured with anchor pins. Overlaps shall be at least 18 inches, and anchor pins shall be used along the overlaps.

3.2.2 Installation of Pipe for Subdrains

3.2.2.1 Pipelaying

Each pipe shall be carefully inspected before it is laid. Any defective or damaged pipe shall be rejected. No pipe shall be laid when the trench conditions or weather is unsuitable for such work. Water shall be removed from trenches by sump pumping or other approved methods. The pipe shall be laid to the grades and alignment as indicated. The pipe shall be bedded to the established gradeline. Perforations shall be centered on the bottom of the pipe. Pipes of either the bell-and-spigot type or the tongue-and-groove type shall be laid with the bell or groove ends upstream. All pipes in place shall be approved before backfilling.

3.2.2.2 Jointings

- a. Perforated Corrugated Polyethylene Pipe: Perforated corrugated polyethylene drainage pipe shall be installed in accordance with

the manufacturer's specifications and as specified herein. A pipe with physical imperfections shall not be installed. No more than 5 percent stretch in a section will be permitted.

3.3 INSTALLATION OF FILTER MATERIAL AND BACKFILLING FOR SUBDRAINS

After pipe for subdrains has been laid, inspected, and approved, filter material shall be placed around and over the pipe to the depth indicated. The filter material shall be placed in layers not to exceed 8 inches thick, and each layer shall be thoroughly compacted by mechanical tampers or rammers to obtain the required density. Compaction of filter material and the placement and compaction of overlying backfill material shall be in accordance with the applicable provisions specified in Section 02316 EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS.

-- End of Section --

SECTION TABLE OF CONTENTS

DIVISION 02 - SITE WORK

SECTION 02630

STORM-DRAINAGE SYSTEM

04/01

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 SUBMITTALS
- 1.3 DELIVERY, STORAGE, AND HANDLING
 - 1.3.1 Delivery and Storage
 - 1.3.2 Handling

PART 2 PRODUCTS

- 2.1 PIPE FOR CULVERTS AND STORM DRAINS
 - 2.1.1 Concrete Pipe
 - 2.1.1.1 Pipe Through Levees
 - 2.1.2 Corrugated Steel Pipe
- 2.2 DRAINAGE STRUCTURES
 - 2.2.1 Grated Steel Pipe Flared End Sections
 - 2.2.2 Precast Concrete Flared End Sections
- 2.3 MISCELLANEOUS MATERIALS
 - 2.3.1 Concrete
 - 2.3.2 Mortar
 - 2.3.3 Precast Reinforced Concrete Manholes
 - 2.3.4 Frame and Cover
 - 2.3.5 Joints
 - 2.3.5 Flexible Watertight Joints
 - 2.3.6 Separation Geotextile
- 2.4 STEEL LADDER
 - 2.4.1 Cast-In-Place Concrete Structures
 - 2.4.2 Precast Concrete Manholes
- 2.5 RESILIENT CONNECTORS
- 2.6 INSULATION

PART 3 EXECUTION

- 3.1 EXCAVATION FOR PIPE CULVERTS, STORM DRAINS, AND DRAINAGE STRUCTURES
 - 3.1.1 Trenching
 - 3.1.2 Removal of Unstable Material
- 3.2 BEDDING
 - 3.2.1 Concrete Pipe Requirements
 - 3.2.2 Corrugated Metal Pipe
- 3.3 PLACING PIPE
 - 3.3.1 Concrete Pipe

- 3.3.2 Corrugated Metal Pipe
- 3.3.3 Jacking Pipe Through Fills
- 3.4 JOINTING
 - 3.4.1 Concrete Pipe
 - 3.4.1.1 Flexible Watertight Joints
 - 3.4.2 Corrugated Metal Pipe
 - 3.4.2.1 Field Joints
 - 3.4.2.2 Flexible Watertight, Gasketed Joints
- 3.5 GEOTEXTILE WRAP
- 3.6 DRAINAGE STRUCTURES
 - 3.6.1 Manholes
 - 3.6.2 Cast-In-Place Structures
- 3.7 STEEL LADDER AND MANHOLE STEPS INSTALLATION
- 3.8 MOVEMENT OF CONSTRUCTION MACHINERY
- 3.9 INSULATION

-- End of Section Table of Contents --

SECTION 02630

STORM-DRAINAGE SYSTEM

04/01

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

ACI INTERNATIONAL (ACI)

ACI 346/346R (1990) Standard Specification for
Cast-in-Place Nonreinforced Concrete Pipe
and Recommendations

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS
(AASHTO)

AASHTO HB-16 (1996) Standard Specifications for Highway
Bridges

AASHTO M 198 (1998) Joints for Circular Concrete Sewer
and Culvert Pipe Using Flexible Watertight
Gaskets

AMERICAN RAILWAY ENGINEERING AND MAINTENANCE-OF-WAY ASSOCIATION
(AREMA)

AREMA Manual (1999) Manual for Railway Engineering (4
Vol.)

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 48 (1994a) Specification for Gray Iron
Castings

ASTM A 123 (1997a) Zinc (Hot-Dip Galvanized)
Coatings on Iron and Steel Products

ASTM A 536 (1993) Specification for Ductile Iron
Castings

ASTM A 760 (1997) Corrugated Steel Pipe,
Metallic-Coated for Sewers and Drains

ASTM A 798	(1997a) Installing Factory-Made Corrugated Steel Pipe for Sewers and Other Applications
ASTM A 929	(1997) Steel Sheet, Metallic-Coated by the Hot-Dip Process for Corrugated Steel Pipe
ASTM B 26	(1997) Specification for Aluminum-Alloy Sand Castings
ASTM C 14	(1999) Concrete Sewer, Storm Drain, and Culvert Pipe
ASTM C 76	(1999) Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
ASTM C 231	(1997e1) Air Content of Freshly Mixed Concrete by the Pressure Method Clay Pipe and Fittings
ASTM C 270	(1995a) Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service
ASTM C 425	(1997) Specification for Compression Joints for Vitrified Clay Pipe and Fittings
ASTM C 443	(1998) Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets
ASTM C 478	(1997) Precast Reinforced Concrete Manhole Sections
ASTM C 789	(1998) Precast Reinforced Concrete Box Sections for Culverts, Storm Drains, and Sewers
ASTM C 850	(1998) Precast Reinforced Concrete Box Sections for Culverts, Storm Drains, and Sewers with Less Than 2 Ft. of Cover Subjected to Highway Loadings
ASTM C 923	(1998) Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Materials
ASTM C 924	(1998) Concrete Pipe Sewer Lines by Low-Pressure Air Test Method
ASTM C 1103	(1994) Joint Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines Sponge or Expanded Rubber

ASTM D 1171	(1994) Rubber Deterioration - Surface Ozone Cracking Outdoors or Chamber (Triangular Specimens)
ASTM D 1557	(1998) Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/cu. ft. (2,700 kN-m/cu.m.))
ASTM D 2167	(1994) Density and Unit Weight of Soil in Place by the Rubber Balloon Method
ASTM D 2842	Test Method for Water Absorption of Rigid Plastics
ASTM D 2922	(1996el) Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
ASTM D 3017	(1988; R 1996el) Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)

1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with SECTION 01330: SUBMITTAL PROCEDURES:

SD-13 Certificates

Test Reports; FIO.

Certified copies of test reports demonstrating conformance to applicable pipe specifications, before pipe is installed. Certification on the ability of frame and cover to carry the imposed live load.

1.3 DELIVERY, STORAGE, AND HANDLING

1.3.1 Delivery and Storage

Materials delivered to site shall be inspected for damage, unloaded, and stored with a minimum of handling. Materials shall not be stored directly on the ground. The inside of pipes and fittings shall be kept free of dirt and debris. The Contractor shall have a copy of the manufacturer's instructions available at the construction site at all times and shall follow these instructions unless directed otherwise by the Contracting Officer.

1.3.2 Handling

Materials shall be handled in a manner that ensures delivery to the trench in sound, undamaged condition. Pipe shall be carried to the trench, not

dragged.

PART 2 PRODUCTS

2.1 PIPE FOR CULVERTS AND STORM DRAINS

Pipe for culverts and storm drains shall be of the sizes indicated and shall conform to the requirements specified.

2.1.1 Concrete Pipe

ASTM C 76, Class as indicated on the Drawings.

2.1.1.1 Pipe Through Levees

Concrete pipe outlets through the levees, from the pump stations and gatewells, shall be constructed of pipe sections a maximum of 4 feet in length.

2.1.2 Corrugated Steel Pipe

ASTM A 760, zinc or aluminum (Type 2) coated pipe of either:

- a. Type I pipe with annular or helical 2-2/3 by 1/2 inch corrugations.
- b. Type IR pipe with helical 3/4 by 3/4 by 7-1/2 inch corrugations.

2.2 DRAINAGE STRUCTURES

2.2.1 Grated Steel Pipe Flared End Sections

Sections shall be of a standard design fabricated from zinc coated steel sheets meeting requirements of ASTM A 929.

2.2.2 Precast Concrete Flared End Sections

Sections shall be of a standard design in accordance with ASTM C 76, Class II. Steel trash racks shall be provided for concrete flared end sections where indicated. Trash racks shall be in accordance with SECTION 05055: METALWORK FABRICATION, MACHINE WORK, MISCELLANEOUS PROVISIONS.

2.3 MISCELLANEOUS MATERIALS

2.3.1 Concrete

Concrete for junction manholes, gatewells, and pump stations shall conform to the requirements of SECTION 03300 CAST-IN-PLACE-STRUCTURAL CONCRETE.

2.3.2 Mortar

Mortar for pipe joints, connections to other drainage structures, and brick or block construction shall conform to ASTM C 270, Type M, except that the

maximum placement time shall be 1 hour. The quantity of water in the mixture shall be sufficient to produce a stiff workable mortar. Water shall be clean and free of harmful acids, alkalies, and organic impurities.

The mortar shall be used within 30 minutes after the ingredients are mixed with water. The inside of the joint shall be wiped clean and finished smooth. The mortar head on the outside shall be protected from air and sun with a proper covering until satisfactorily cured.

2.3.3 Precast Reinforced Concrete Manholes

Precast reinforced concrete manholes shall conform to ASTM C 478. Joints between precast concrete sections shall be made with flexible watertight, rubber-type gaskets meeting the requirements of paragraph JOINTS.

2.3.4 Frame and Cover

Frame and cover shall be cast gray iron, ASTM A 48, Class 35B; cast ductile iron, ASTM A 536, Grade 65-45-12; or cast aluminum, ASTM B 26, Alloy 356.OT6. Frame and cover model for grates and curb inlets shall be as indicated on the Drawings. All castings and frames shall be capable of withstanding a HS20 wheel load.

2.3.5 Joints

2.3.5 Flexible Watertight Joints

- a. Materials: Flexible watertight joints shall be made with plastic or rubber-type gaskets for concrete pipe. The design of joints and the physical requirements for plastic gaskets shall conform to AASHTO M 198, and rubber-type gaskets shall conform to ASTM C 443. Factory-fabricated resilient joint materials shall conform to ASTM C 425. Gaskets shall have not more than one factory-fabricated splice, except that two factory-fabricated splices of the rubber-type gasket are permitted if the nominal diameter of the pipe or manhole being gasketed exceeds 54 inches.

2.3.6 Separation Geotextile

Separation geotextile shall be as specified in SECTION 02373: SEPARATION GEOTEXTILE.

2.4 STEEL LADDER

2.4.1 Cast-In-Place Concrete Structures

Steel ladders shall be provided for cast-in-place concrete structures, including pump stations and gatewells, as shown. Ladders shall not be placed in junction manholes. Ladders shall be in accordance with SECTION 05055: METALWORK FABRICATION, MACHINE WORK, MISCELLANEOUS PROVISIONS. Ladders and inserts shall be galvanized after fabrication in conformance with ASTM A 123.

2.4.2 Precast Concrete Manholes

Steel ladders shall be provided for precast manholes 12-feet in depth or greater. Ladders shall be as shown. Ladders shall be in accordance with SECTION 05055: METALWORK FABRICATION, MACHINE WORK, MISCELLANEOUS PROVISIONS. Ladders and inserts shall be galvanized after fabrication in conformance with ASTM A 123.

Manhole steps shall be provided for manholes less than 12-feet in depth. Manhole steps shall be a minimum of 12-inches wide with rungs spaced 12-inches apart. Manhole steps shall be cast aluminum or polypropylene-coated steel.

2.5 RESILIENT CONNECTORS

Flexible, watertight connectors used for connecting pipe to manholes and inlets shall conform to ASTM C 923.

2.6 INSULATION

Insulation shall be rigid, extruded polystyrene board with minimum thermal resistance (R) of 5.0. Board size shall be 48-inch x 96-inch or equal to size of the structure base slab. Edges shall be square. Compressive strength shall be minimum 25 psi. Water absorption shall be maximum 0.1 percent in accordance with ASTM D 2842. Minimum thickness of individual boards shall be 1-inch.

PART 3 EXECUTION

3.1 EXCAVATION FOR PIPE CULVERTS, STORM DRAINS, AND DRAINAGE STRUCTURES

Excavation of trenches, and for appurtenances and backfilling for culverts and storm drains, shall be in accordance with the applicable portions of SECTION 02316: "EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITY SYSTEMS" and SECTION 02300: "EARTHWORK" and the requirements specified below. Excavation and backfill for junction manholes, pump stations, and gatewell structures shall be in accordance with SECTION 02315: EXCAVATION, FILLING AND BACKFILLING FOR STRUCTURES.

Interruption of River Road, 4th Street NW, and Highway 2 in Reach 1, for installation of storm sewer piping will not be allowed. Storm sewer piping in these areas, listed below, shall be installed using jacking techniques.

- 1) Pump station K-7 outlet pipes under River Road.
- 2) Pump station K-10 outlet pipes under 4th Street NW
- 3) Storm sewer piping from approximately 8th Avenue and 10th Street on the North side of Highway 2 to the South side of Highway 2.

3.1.1 Trenching

The width of trenches at any point below the top of the pipe shall be not greater than the outside diameter of the pipe plus 36 inches to permit satisfactory jointing and thorough tamping of the bedding material under and around the pipe. Sheet piling and bracing, where required, shall be placed within the trench width as specified. Contractor shall not overexcavate. Where trench widths are exceeded, redesign with a resultant increase in

cost of stronger pipe or special installation procedures will be necessary.

Cost of this redesign and increased cost of pipe or installation shall be borne by the Contractor without additional cost to the Government.

3.1.2 Removal of Unstable Material

Where wet or otherwise unstable soil incapable of properly supporting the pipe, as determined by the Contracting Officer, is unexpectedly encountered in the bottom of a trench, such material shall be removed to the depth required and replaced to the proper grade with satisfactory material, compacted as provided in paragraph BACKFILLING. When removal of unstable material is due to the fault or neglect of the Contractor in his performance of shoring and sheeting, water removal, or other specified requirements, such removal and replacement shall be performed at no additional cost to the government.

3.2 BEDDING

The bedding surface for the pipe shall provide a firm foundation of uniform density throughout the entire length of the pipe.

3.2.1 Concrete Pipe Requirements

When no bedding class is specified or detailed on the drawings, concrete pipe shall be bedded in a soil foundation accurately shaped and rounded to conform to the lowest one-fourth of the outside portion of circular pipe or to the lower curved portion of pipe arch for the entire length of the pipe or pipe arch. When necessary, the bedding shall be tamped. Bell holes and depressions for joints shall be not more than the length, depth, and width required for properly making the particular type of joint.

3.2.2 Corrugated Metal Pipe

Bedding for corrugated metal pipe and pipe arch shall be in accordance with ASTM A 798. It is not required to shape the bedding to the pipe geometry.

3.3 PLACING PIPE

Each pipe shall be thoroughly examined before being laid; defective or damaged pipe shall not be used. Pipe shall be laid to the grades and alignment indicated. Proper facilities shall be provided for lowering sections of pipe into trenches. Pipe shall not be laid in water, and pipe shall not be laid when trench conditions or weather are unsuitable for such work. Diversion of drainage or dewatering of trenches during construction shall be provided as necessary. Deflection of installed flexible pipe shall not exceed the following limits:

TYPE OF PIPE	MAXIMUM ALLOWABLE DEFLECTION (%)
Corrugated Steel	5

Not less than 30 days after the completion of backfilling, the Government may perform a deflection test on the entire length of installed flexible

pipe using a mandrel or other suitable device. Installed flexible pipe showing deflections greater than those indicated above shall be retested by a run from the opposite direction. If the retest also fails, the suspect pipe shall be replaced at no cost to the Government.

3.3.1 Concrete Pipe

Laying shall proceed upgrade with spigot ends of bell-and-spigot pipe and tongue ends of tongue-and-groove pipe pointing in the direction of the flow.

3.3.2 Corrugated Metal Pipe

Laying shall be with the separate sections joined firmly together, with the outside laps of circumferential joints pointing upstream, and with longitudinal laps on the sides.

3.3.3 Jacking Pipe Through Fills

Methods of operation and installation for jacking pipe through fills shall conform to requirements specified in Volume 1, Chapter 1, Part 4 of AREMA Manual. Jacked pipe shall be installed in a welded steel casing pipe. The steel casing pipe shall be wrapped in minimum 8 mil thick polyethylene. The void between the casing pipe and the storm sewer piping shall be filled with sand or other approved material.

3.4 JOINTING

3.4.1 Concrete Pipe

3.4.1.1 Flexible Watertight Joints

Gaskets and jointing materials shall be as recommended by the particular manufacturer in regard to use of lubricants, cements, adhesives, and other special installation requirements. Surfaces to receive lubricants, cements, or adhesives shall be clean and dry. Gaskets and jointing materials shall be affixed to the pipe not more than 24 hours prior to the installation of the pipe, and shall be protected from the sun, blowing dust, and other deleterious agents at all times. Gaskets and jointing materials shall be inspected before installing the pipe; any loose or improperly affixed gaskets and jointing materials shall be removed and replaced. The pipe shall be aligned with the previously installed pipe, and the joint pushed home. If, while the joint is being made the gasket becomes visibly dislocated the pipe shall be removed and the joint remade.

3.4.2 Corrugated Metal Pipe

3.4.2.1 Field Joints

Transverse field joints shall be designed so that the successive connection of pipe sections will form a continuous line free of appreciable irregularities in the flow line. In addition, the joints shall meet the general performance requirements described in ASTM A 798. Suitable transverse field joints which satisfy the requirements for one or more of the joint performance categories can be obtained with the following types

of connecting bands furnished with suitable band-end fastening devices: corrugated bands, bands with projections, flat bands, and bands of special design that engage factory reformed ends of corrugated pipe. The space between the pipe and connecting bands shall be kept free from dirt and grit so that corrugations fit snugly. The connecting band, while being tightened, shall be tapped with a soft-head mallet of wood, rubber or plastic, to take up slack and ensure a tight joint. Field joints for each type of corrugated metal pipe shall maintain pipe alignment during construction and prevent infiltration of fill material during the life of the installations. The type, size, and sheet thickness of the band and the size of angles or lugs and bolts shall be as indicated or where not indicated, shall be as specified in the applicable standards or specifications for the pipe.

3.4.2.2 Flexible Watertight, Gasketed Joints

Installation shall be as recommended by the gasket manufacturer for use of lubricants and cements and other special installation requirements. The gasket shall be placed over one end of a section of pipe for half the width of the gasket. The other half shall be doubled over the end of the same pipe. When the adjoining section of pipe is in place, the doubled-over half of the gasket shall then be rolled over the adjoining section. Any unevenness in overlap shall be corrected so that the gasket covers the end of pipe sections equally. Connecting bands shall be centered over adjoining sections of pipe, and rods or bolts placed in position and nuts tightened. Band Tightening: The band shall be tightened evenly, even tension being kept on the rods or bolts, and the gasket; the gasket shall seat properly in the corrugations. Watertight joints shall remain uncovered for a period of time designated, and before being covered, tightness of the nuts shall be measured with a torque wrench. If the nut has tended to loosen its grip on the bolts or rods, the nut shall be retightened with a torque wrench and remain uncovered until a tight, permanent joint is assured.

3.5 GEOTEXTILE WRAP

Storm drainage piping installed in the levee embankment shall be wrapped in separation geotextile as shown.

3.6 DRAINAGE STRUCTURES

3.6.1 Manholes

Construction shall be of precast reinforced concrete with flexible watertight joints, complete with frames and covers or grates, and with fixed galvanized steel ladders or manhole steps.

3.6.2 Cast-In-Place Structures

Construction shall be in accordance with SECTION 03300: CAST-IN-PLACE STRUCTURAL CONCRETE.

3.7 STEEL LADDER AND MANHOLE STEPS INSTALLATION

Steel ladder shall be installed as shown. Manhole steps shall be adequately anchored to the wall by means of steel inserts.

3.8 MOVEMENT OF CONSTRUCTION MACHINERY

When compacting by rolling or operating heavy equipment parallel with the pipe, displacement of or injury to the pipe shall be avoided. Movement of construction machinery over a culvert or storm drain at any stage of construction shall be at the Contractor's risk. Any damaged pipe shall be replace and joints repaired.

3.9 INSULATION

Insulation shall be installed where shown and to the thickness shown. Joints, if necessary, shall be staggered.

-- End of Section --

SECTION TABLE OF CONTENTS

DIVISION 02 - SITE WORK

SECTION 02722

AGGREGATE BASE OR SURFACE COURSE

04/01

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 SUBMITTALS

PART 2 PRODUCTS

- 2.1 REQUIREMENTS
- 2.2 MATERIALS
 - 2.2.1 Aggregate Base Course
 - 2.2.2 Aggregate Surfacing Course

PART 3 EXECUTION

- 3.1 GENERAL
- 3.2 TESTING
 - 3.2.1 General
 - 3.2.2 Transmittal
 - 3.2.3 Corrective Action
 - 3.2.4 Sampling
 - 3.2.5 Liquid Limit and Plasticity Index
 - 3.2.6 LA Abrasion
 - 3.2.7 Sieve Analysis
 - 3.2.8 Moisture Density Determination
 - 3.2.9 Field Density and Water Content
 - 3.2.10 Subgrade Tolerances

-- End of Section Table of Contents --

SECTION 02722

AGGREGATE BASE OR SURFACE COURSE

04/01

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 131	(1996) Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM D 75	(1997) Sampling Aggregates
ASTM D 422	(1963;R 1990) Particle-Size Analysis of Soils
ASTM D 698	(1991) Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/CF)
ASTM D 2922	Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
ASTM D 4318	(1995a) Liquid Limit, Plastic Limit, and Plasticity Index of Soils

MINNESOTA DEPARTMENT OF TRANSPORTATION (MNDOT), STANDARD SPECIFICATIONS FOR CONSTRUCTION (1995 EDITION AND SUPPLEMENTS)

MNDOT 2112	Subgrade Preparation
MNDOT 2211	Aggregate Base
MNDOT 3138	Aggregates for Surface and Base Courses

1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-09 Reports

Testing; FIO

A summary of sampling and testing results indicated in PARAGRAPH: TESTING shall be submitted when the road work is substantially complete.

PART 2 PRODUCTS

2.1 REQUIREMENTS

All products shall meet the requirements of the specified sections of the MNDOT Standard Specifications, except where modified or required below. Aggregate gradations, as indicated by class, for aggregate base course and surface course specified in the MNDOT Standard Specifications shall be strictly adhered to.

2.2 MATERIALS

2.2.1 Aggregate Base Course

Aggregate base course shall consist of crushed concrete unless otherwise noted or required for reconstructed street sections. Crushed concrete shall consist of previously hardened portland cement concrete or other concrete containing pozzolanic binder material. The crushed concrete shall be free of all reinforcing steel, wire mesh, bituminous concrete, and any other foreign material. Crush and process the concrete to meet the required gradations as identified by class and all other requirements of MNDOT 2211 and MNDOT 3138, except the maximum particle size allowed for crushed concrete is 1-1/2 inches. Replace base course of reconstructed street sections in kind meeting MNDOT 2211 and MNDOT 3138.

2.2.2 Aggregate Surfacing Course

Aggregate surfacing course shall consist of crushed gravel graded to the class shown and meeting the requirements of MNDOT 3138.

PART 3 EXECUTION

3.1 GENERAL

Furnishing, placing, compaction, subgrade preparation, and testing shall meet the requirements of the MNDOT 2112, MNDOT 2211, and MNDOT 3138. Compaction shall be in accordance with the specified density method.

3.2 TESTING

3.2.1 General

All testing expenses shall be the Contractor's responsibility. Prior to sampling and testing the work, testing laboratories shall be inspected and approved in accordance with SECTION 01451: CONTRACTOR QUALITY CONTROL.

3.2.2 Transmittal

The Contracting Officer shall be informed of test results daily for direction or corrective action required. Draft copies of field testing results shall be submitted to the Contracting Officer within 24 hours of the test, as directed.

3.2.3 Corrective Action

Tests of materials which do not meet the contract requirements (failing tests) will not be counted as part of the required testing. Each such failing test must be retaken at the same location as the failing test was taken. If testing indicates material does not meet the contract requirements, the material represented by the failing test shall be removed. The quantity of material represented by the failing test shall be determined by the Contracting Officer up to the quantity represented by the testing frequency. The Contractor may increase testing frequency in the vicinity of a failing test in order to reduce removal requirements, as approved by the Contracting Officer. Such increases in testing frequency shall be at the Contractor's expense and at no additional cost to the Government.

3.2.4 Sampling

Sampling shall be done in accordance with ASTM D 75. Properties shall be determined from three random samples taken from the stockpile from each lot of 5,000 tons or fraction thereof at the source prior to delivery to the site.

3.2.5 Liquid Limit and Plasticity Index

Liquid Limit and Plasticity Index shall be tested in accordance with ASTM D 4318, respectively. The portion of the material passing the No. 40 sieve must have a liquid limit not greater than 25 and a plasticity index not greater than 5.

3.2.6 LA Abrasion

LA Abrasion shall be tested in accordance with ASTM C 131. Results must meet the requirements of the MNDOT 3138.

3.2.7 Sieve Analysis

Sieve Analysis shall be made in conformance with ASTM D 422. Satisfactory results are specified in MNDOT 3138.

3.2.8 Moisture Density Determination

The maximum density and optimum moisture content shall be determined in accordance with ASTM D 698.

3.2.9 Field Density and Water Content

In-place density shall be field verified in accordance with ASTM D 2922. Water content shall be maintained during the compaction procedure to within

plus or minus 3 percent of the optimum water content. Compaction shall continue until each layer has a degree of compaction that is at least 100 percent of the laboratory maximum density through the full depth of the layer. Testing shall occur at random intervals on every 2,000 tons of aggregate base or surface course installed or fraction thereof.

3.2.10 Subgrade Tolerances

Tolerances are provided in MNDOT 2211.

-- End of Section --

SECTION TABLE OF CONTENTS

DIVISION 02 - SITE WORK

SECTION 02741

PLANT-MIXED BITUMINOUS PAVEMENT

04/01

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 SUBMITTALS

PART 2 PRODUCTS

- 2.1 TACK COAT
- 2.2 BITUMINOUS PAVEMENT
 - 2.2.1 Wearing Course
 - 2.2.2 Non Wearing Course (Base Course)

PART 3 EXECUTION

- 3.1 GENERAL
- 3.2 TESTING
 - 3.2.1 General
 - 3.2.2 Transmittal
 - 3.2.3 Response to Results and Corrective Action
 - 3.2.4 Testing Schedule

-- End of Section Table of Contents --

SECTION 02741

PLANT-MIXED BITUMINOUS PAVEMENT
04/01

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 117	(1995) Test Method for Material Finer Than 75-um (No. 200) Sieve in Mineral Aggregates by Washing
ASTM C 136	(1996a) Test Method for Sieve Analysis of Fine and Coarse Aggregates
ASTM D 2172	(1995) Test Methods for Quantitative Extraction of Bitumen From Bituminous Paving Mixtures

MINNESOTA DEPARTMENT OF TRANSPORTATION (MNDOT) STANDARD
SPECIFICATIONS FOR CONSTRUCTION (1995 EDITION WITH SUPPLEMENTS)

MNDOT 2331	Plant Mixed Bituminous Pavement
MNDOT 2340	Plant-Mixed Bituminous Pavement Quality Control/Quality Assurance
MNDOT 2357	Bituminous Tack Coat
MNDOT 3139	Graded Aggregate for Bituminous Mixtures

1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with SECTION 01330: SUBMITTAL PROCEDURES:

SD-07 Schedules

Paving Schedule; FIO

Submit paving schedule at least 7 days prior to start of paving.

SD-09 Reports

Testing; FIO.

The Contractor shall submit complete records of all quality control test and inspections. All test results and calculations will be recorded and documented on data sheets approved by the Contracting Officer. Data sheets shall list the mix design criteria, job mix formula, testing requirements and results.

Mix Design; GA.

At least ten days prior to placement of bituminous pavement the Contractor shall submit the mix proportions that meet the requirements specified in the MNDOT Standard Specifications and that will produce bituminous pavement of the quality required. The mix design will be developed according to the MNDOT Standard Specifications. The mix design in Table 2331-14 of MNDOT 2331 shall have the properties required.

If aggregate or asphalt is utilized from sources other than those initially submitted with the mix proportions, the aggregate is processed using a different crusher, or if a different type or grade of asphalt is used, the Contractor shall notify the Contracting Officer in writing before incorporating the material into the work. If the Contracting Officer determines that a new mix design is required, the Contractor shall submit another mix design and submit it for approval.

Job Mix Formula (JMF)

The results of the mix design process is the Job Mix Formula. The JMF submitted shall contain the following:

1. The percentage of aggregate passing each of the specified sieves.
2. The percent asphalt cement to be added to the mixture.
3. The target air voids will be 4 percent.
4. The maximum specific gravity of the mixture obtained in the laboratory.
5. The bulk specific gravity of the mixture obtained in the laboratory.
6. The percent VMA of the mixture obtained in the laboratory.
7. The Stability of the mix.
8. Flow.

9. Calculated Film Thickness (Microns).*

10. Calculated Dust/Asphalt Ratio.**

PART 2 PRODUCTS

All products shall meet the requirements of the referenced sections of the MNDOT Standard Specifications. Aggregate shall be A, B, C, or D, as specified in the MNDOT 3139. Asphalt type and grade shall be as indicated in MNDOT 2331.

2.1 TACK COAT

Tack coat shall meet the requirements of MNDOT 2357.

2.2 BITUMINOUS PAVEMENT

2.2.1 Wearing Course

The wearing course shall consist of Type 41 as specified in MNDOT 2331. The lift thickness for wearing course shall not exceed 2 inches.

2.2.2 Non Wearing Course (Base Course)

The non-wearing course shall consist of Type 31 as specified in MNDOT 2331. The lift thickness for non-wearing course shall not exceed 2 inches.

PART 3 EXECUTION

3.1 GENERAL

Refer to SECTION 02722: AGGREGATE BASE OR SURFACE COURSE for subgrade preparation and aggregate base.

Furnishing, paving, finishing, compaction, and installation of Plant Mixed Bituminous Pavement shall meet the requirements of the specified sections of the MNDOT Standard Specifications, except as otherwise required herein. Where referenced in the MNDOT Standard Specifications, Engineer shall mean the Contracting Officer and Department shall mean the Government.

For road reconstruction the Contractor shall take a minimum of 3 road cores from each section. Road cores shall be tested for thickness of wear course and non-wear course, asphalt cement content, and aggregate gradation. Replace each section in kind. The Contractor will have the option to use the approved JMF provided it exceeds the quality of the existing pavement section and approval is obtained in writing from the Contracting Officer.

3.2 TESTING

3.2.1 General

All testing expenses shall be the Contractor's responsibility. Prior to sampling and testing the work, testing laboratories shall be inspected and

approved in accordance with SECTION 01451: CONTRACTOR QUALITY CONTROL. All testing shall conform with the requirements of MNDOT 2340.

3.2.2 Transmittal

The Contracting Officer shall be informed of test results daily for direction or corrective action required. Draft copies of field testing results shall be submitted to the Contracting Officer within 24 hours of the test, as directed.

3.2.3 Response to Results and Corrective Action

As required in MNDOT 2340.

3.2.4 Testing Schedule

Perform the following testing; the frequency of testing listed applies to each separate area paved. Core samples will be used to measure the thickness and specified density. Compare Marshall density test results from the bag samples to the bituminous mixture core samples to determine the pay factor in accordance with MNDOT 2331.

<u>Material</u>	<u>Test</u>	<u>Frequency</u>
Aggregate for Bituminous Mixture	Sieve Analysis (ASTM C 117 & ASTM C 136)	Every 125 Cubic Yards
Bituminous Non-Wearing and Wearing Course	Core Samples (MNDOT 2331)	3 for each course
	Extraction (ASTM D 2172)	3 for each course
	Marshall Density	1 for each course

-- End of Section --

SECTION TABLE OF CONTENTS

DIVISION 02 - SITE WORK

SECTION 02754

CONCRETE BASE AND PAVEMENT

04/01

PART 1 GENERAL

1.1 REFERENCES

1.2 SUBMITTALS

PART 2 PRODUCTS

2.1 MATERIALS

PART 3 EXECUTION

3.1 GENERAL

3.2 TESTING

3.2.1 General

3.2.2 Transmittal

3.2.3 Corrective Action

3.2.4 Testing Schedule

-- End of Section Table of Contents --

SECTION 02754
CONCRETE BASE AND PAVEMENT

04/01

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

MINNESOTA DEPARTMENT OF TRANSPORTATION STANDARD SPECIFICATIONS FOR
CONSTRUCTION (1995 EDITION AND SUPPLEMENTS)

MNDOT 2201	Concrete Base
MNDOT 2301	Concrete Pavement
MNDOT 2461	Structural Concrete

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 39	(1996) Compressive Strength of Cylindrical Concrete Specimens
ASTM C 143	(1990a) Slump of Hydraulic Cement Concrete
ASTM C 231	(1997) Air Content of Freshly Mixed Concrete by the Pressure Method

1.2 SUBMITTALS

Government approval is required for all submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with SECTION 01330: SUBMITTAL PROCEDURES.

SD-07 Schedules

Paving Schedule; FIO

Paving schedule at least 7 days prior to start of paving.

SD-09 Reports

Concrete Mixture Proportions; GA

At least ten days prior to placement of concrete, the Contractor shall submit the mixture proportions that meet requirements specified in the 1995 MNDOT Standard specifications and that will produce concrete of the quality required. Applicable test reports shall be submitted to verify that the concrete mixture proportions meet requirements specified in the 1995 MNDOT Standard specifications and will produce concrete of the quality specified.

Testing; FIO

A summary of testing results indicated in PARAGRAPH: TESTING shall be submitted when concrete work is substantially complete for each paved area.

PART 2 PRODUCTS

2.1 MATERIALS

All products shall meet the requirements of the specified sections of the 1995 MNDOT Standard Specifications, Sections: MNDOT 2201, MNDOT 2301, MNDOT 2461.

PART 3 EXECUTION

3.1 GENERAL

Refer to SECTION 02722: AGGREGATE BASE OR SURFACE COURSE for subgrade preparation and aggregate base.

Concrete pavement construction, finishing, curing, joints, and testing for roads and driveways shall meet the requirements specified in the 1995 Minnesota Department of Transportation Standard Specifications for construction (1995 MNDOT Standard Specifications), Sections: MNDOT 2201, MNDOT 2301, MNDOT 2461

3.2 TESTING

3.2.1 General

All testing expenses shall be the Contractor's responsibility. Prior to sampling and testing the work, testing laboratories shall be inspected and approved in accordance with SECTION 01451: CONTRACTOR QUALITY CONTROL.

3.2.2 Transmittal

The Contracting Officer shall be informed of test results daily for direction or corrective action required. Draft copies of field testing results shall be submitted to the Contracting Officer within 24 hours of the test, as directed.

3.2.3 Corrective Action

Tests of materials which do not meet the contract requirements (failing tests) will not be counted as part of the required testing. Each such failing test must be retaken at the same location as the failing test was taken. If testing indicates material does not meet the contract

requirements, the material represented by the failing test shall be removed. The quantity of material represented by the failing test shall be determined by the Contracting Officer up to the quantity represented by the testing frequency. The Contractor may increase testing frequency in the vicinity of a failing test in order to reduce removal requirements, as approved by the Contracting Officer. Such increases in testing frequency shall be at the Contractor's expense and at no additional cost to the Government.

3.2.4 Testing Schedule

a. Surface Smoothness

The finished surfaces of the pavements shall have no abrupt change of 1/8 inch or more, and all pavements shall be within the tolerances specified in Table 1 when checked with the straightedge.

Table 1
Straightedge Surface Smoothness - Pavements

<u>Pavement Category</u>	<u>Direction of Testing</u>	<u>Tolerances (Inches)</u>
Roads and Streets	Longitudinal	3/16
	Transverse	1/4
Tank Hardstrands, Parking Areas, Open Storage Areas	Longitudinal	1/4
	Transverse	1/4

The surface of the pavement shall be tested with the straightedge to identify all surface irregularities exceeding the tolerances specified above. The entire area of the pavement shall be tested in both a longitudinal and a transverse direction on parallel lines approximately 15 feet apart. The straightedge shall be held in contact with the surface and moved ahead one-half the length of the straightedge for each successive measurement. The amount of surface irregularity shall be determined by placing the straightedge on the pavement surface and allowing it to rest upon the two highest spots covered by its length and measuring the maximum gap between the straightedge and the pavement surface in the area between these two high points.

b. Strength Tests

Compressive tests shall be made to determine that concrete strength specified in MNDOT 2461 is achieved prior to opening pavement to traffic.

Compressive tests will be made and cured according to ASTM C 39.

Concrete cylinders will be tested for compressive strength according to ASTM C 39. 1 set of 5 cylinders per 4,000 square yards or fraction thereof shall be sampled and tested for each pavement or driveway area.

c. Tests for Uniformity

Uniformity will be tested by comparing slump (ASTM C 143), and air content (

ASTM C 231) of 2 individual samples taken from approximately the 1/6 and 5/6 points of the batch as discharged at the site of placement. Satisfactory uniformity results are specified in MNDOT 2461.

-- End of Section --

SECTION TABLE OF CONTENTS

DIVISION 02 - SITE WORK

SECTION 02763

PAVEMENT MARKINGS

04/01

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 SUBMITTALS
- 1.3 DELIVERY AND STORAGE
- 1.4 EQUIPMENT
 - 1.4.1 Pavement Marking Application Equipment
 - 1.4.2 Reflective Media Dispenser
 - 1.4.3 Surface Preparation Equipment
 - 1.4.3.1 Sandblasting Equipment
 - 1.4.3.2 Waterblast Equipment
 - 1.4.4 Marking Removal Equipment
 - 1.4.4.1 Shotblasting Equipment
 - 1.4.4.2 Chemical Equipment
 - 1.4.5 Traffic Controls
- 1.5 HAND-OPERATED, PUSH-TYPE MACHINES
- 1.6 MAINTENANCE OF TRAFFIC
 - 1.6.1 Roads, Streets, and Parking Areas
- 1.7 WEATHER LIMITATIONS FOR REMOVAL

PART 2 PRODUCTS

- 2.1 PAVEMENT MARKINGS
- 2.2 REFLECTIVE MEDIA
- 2.3 SAMPLING AND TESTING

PART 3 EXECUTION

- 3.1 SURFACE PREPARATION
 - 3.1.1 Cleaning Existing Pavement Markings
- 3.2 APPLICATION
 - 3.2.1 Application
 - 3.2.2 Spacing and Layout
- 3.3 PROTECTION OF TRAFFIC AND MARKINGS
- 3.4 MARKING REMOVAL
 - 3.4.1 Equipment Operation
 - 3.4.2 Cleanup and Waste Disposal

-- End of Section Table of Contents --

SECTION 02763

PAVEMENT MARKINGS

04/01

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS
(AASHTO)

AASHTO M 247 (1981) Glass Beads Used in Traffic Paint

MINNESOTA DEPARTMENT OF TRANSPORTATION (MNDOT)

MUTCD Minnesota Manual on Uniform Traffic
Control Devices

Attachment Specification for Epoxy Resin Pavement
Markings (Free of Toxic Heavy Metals)

1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-01 Data

Equipment Lists; GA.

Lists of proposed equipment, including descriptive data, and notifications of proposed Contractor actions as specified in this section. List of removal equipment shall include descriptive data indicating area of coverage per pass, pressure adjustment range, tank and flow capacities, and safety precautions required for the equipment operation.

SD-06 Instructions

Mixing, Thinning and Application; FIO.

Manufacturer's current printed product description and Material Safety Data Sheets (MSDS) for each type paint/color proposed for use.

SD-08 Statements

Qualifications; FIO.

Document certifying that personnel are qualified for equipment operation and handling of chemicals.

SD-09 Reports

Material Tests; FIO.

Certified copies of the test reports, prior to the use of the materials at the jobsite. Testing shall be performed in an approved independent laboratory.

SD-13 Certificates

Volatile Organic Compound (VOC) Content; FIO.

Certificate stating that the proposed pavement marking paint meets the VOC regulations of the local Air Pollution Control District having jurisdiction over the geographical area in which the project is located.

1.3 DELIVERY AND STORAGE

All materials shall be delivered and stored in sealed containers that plainly show the designated name, formula or specification number, batch number, color, date of manufacture, manufacturer's name, and directions, all of which shall be plainly legible at time of use.

1.4 EQUIPMENT

All machines, tools and equipment used in the performance of the work shall be approved and maintained in satisfactory operating condition. Equipment operating on roads and runways shall display low speed traffic markings and traffic warning lights.

1.4.1 Pavement Marking Application Equipment

The equipment to apply pavement marking shall be a self-propelled or mobile-drawn pneumatic spraying machine with suitable arrangements of atomizing nozzles and controls to obtain the specified results. The machine shall have a speed during application not less than 5 mph, and shall be capable of applying the stripe widths indicated, at the paint coverage rate specified in paragraph APPLICATION, and of even uniform thickness with clear-cut edges. Equipment used for marking shall be capable of placing the prescribed number of lines at a single pass as solid lines, intermittent lines or a combination of solid and intermittent lines using a maximum of two different colors of paint as specified. The applicator shall have reservoirs or tanks of sufficient capacity and suitable gauges to apply pavement markings in accordance with requirements specified. Tanks shall be equipped with suitable air-driven mechanical agitators. The spray mechanism shall be equipped with quick-action valves conveniently located, and shall include necessary pressure regulators and

gauges in full view and reach of the operator. Strainers shall be installed in supply lines to ensure freedom from residue and foreign matter that may cause malfunction of the spray guns. The applicator shall be readily adaptable for attachment of an air-actuated dispenser for the reflective media approved for use. Pneumatic spray guns shall be provided for hand application of paint in areas where the mobile applicator cannot be used.

1.4.2 Reflective Media Dispenser

The dispenser for applying the reflective media shall be attached to the pavement marking applicator and shall operate automatically and simultaneously with the applicator through the same control mechanism. The dispenser shall be capable of adjustment and designed to provide uniform flow of reflective media over the full length and width of the stripe at the rate of coverage specified in paragraph APPLICATION, at all operating speeds of the applicator to which it is attached.

1.4.3 Surface Preparation Equipment

1.4.3.1 Sandblasting Equipment

Sandblasting equipment shall include an air compressor, hoses, and nozzles of proper size and capacity as required for cleaning surfaces to be painted. The compressor shall be capable of furnishing not less than 150 cfm of air at a pressure of not less than 90 psi at each nozzle used, and shall be equipped with traps that will maintain the compressed air free of oil and water.

1.4.3.2 Waterblast Equipment

The water pressure shall be specified at 2600 psi at 140 degrees F in order to adequately clean the surfaces to be marked.

1.4.4 Marking Removal Equipment

Equipment shall be mounted on rubber tires and shall be capable of removing markings from the pavement without damaging the pavement surface or joint sealant. Waterblasting equipment shall be capable of producing an adjustable, pressurized stream of water. Sandblasting equipment shall include an air compressor, hoses, and nozzles. The compressor shall be equipped with traps to maintain the air free of oil and water.

1.4.4.1 Shotblasting Equipment

Shotblasting equipment shall be capable of producing an adjustable depth of removal of marking and pavement. Each unit shall be self-cleaning and self-contained, shall be able to confine dust and debris from the operation, and shall be capable of recycling the abrasive for reuse.

1.4.4.2 Chemical Equipment

Chemical equipment shall be capable of application and removal of chemicals from the pavement surface, and shall leave only non-toxic biodegradeable

residue.

1.4.5 Traffic Controls

Suitable warning signs shall be placed near the beginning of the worksite and well ahead of the worksite for alerting approaching traffic from both directions. Small markers shall be placed along newly painted lines to control traffic and prevent damage to newly painted surfaces or displacement of raised pavement markers. Equipment shall be marked with large warning signs indicating slow-moving equipment in operation. Comply with the Minnesota Manual on Uniform Traffic Control Devices (MUTCD).

1.5 HAND-OPERATED, PUSH-TYPE MACHINES

All machines, tools, and equipment used in performance of the work shall be approved and maintained in satisfactory operating condition. Hand-operated push-type machines of a type commonly used for application of markings to pavement surfaces will be acceptable for marking small streets and parking areas. Applicator machine shall be equipped with the necessary paint tanks and spraying nozzles, and shall be capable of uniform application at coverage specified. Sandblasting equipment shall be provided as required for cleaning surfaces to be marked. Hand-operated spray guns shall be provided for use in areas where push-type machines cannot be used.

1.6 MAINTENANCE OF TRAFFIC

1.6.1 Roads, Streets, and Parking Areas

When traffic must be rerouted or controlled to accomplish the work, the necessary warning signs, flagpersons, and related equipment for the safe passage of vehicles shall be provided.

1.7 WEATHER LIMITATIONS FOR REMOVAL

Pavement surface shall be free of snow, ice, or slush. Surface temperature shall be at least 50 degrees F and rising at the beginning of operations, except those involving shot or sand blasting. Operation shall cease during thunderstorms. Operation shall cease during rainfall, except for waterblasting and removal of previously applied chemicals. Waterblasting shall cease where surface water accumulation alters the effectiveness of material removal.

PART 2 PRODUCTS

2.1 PAVEMENT MARKINGS

The pavement markings shall conform with the Attachment, "Specification for Epoxy Resin Pavement Markings (Free of Toxic Heavy Metals)".

2.2 REFLECTIVE MEDIA

Reflective media shall conform to AASHTO M 247, Type I, "Standard Gradation", except that the beads shall have a minimum of 80 percent true spheres.

2.3 SAMPLING AND TESTING

Materials proposed for use shall be stored on the project site in sealed and labeled containers, or segregated at source of supply, sufficiently in advance of needs to allow 60 days for testing. Upon notification by the Contractor that the material is at the site or source of supply, a sample shall be taken by random selection from sealed containers by the Contractor in the presence of a representative of the Contracting Officer. Samples shall be clearly identified by designated name, specification number, batch number, manufacturer's formulation number, project contract number, intended use, and quantity involved. Testing shall be performed in an approved independent laboratory. If materials are approved based on reports furnished by the Contractor, samples will be retained by the Government for possible future testing should the material appear defective during or after application.

PART 3 EXECUTION

3.1 SURFACE PREPARATION

Surfaces to be marked shall be thoroughly cleaned before application of the pavement marking material. Dust, dirt, and other granular surface deposits shall be removed by sweeping, blowing with compressed air, rinsing with water or a combination of these methods as required. Rubber deposits, surface laitance, existing paint markings, and other coatings adhering to the pavement shall be completely removed with scrapers, wire brushes, sandblasting, approved chemicals, or mechanical abrasion as directed. Areas of old pavement affected with oil or grease shall be scrubbed with several applications of trisodium phosphate solution or other approved detergent or degreaser, and rinsed thoroughly after each application. After cleaning, oil-soaked areas shall be sealed with cut shellac to prevent bleeding through the new paint. Pavement surfaces shall be allowed to dry, when water is used for cleaning, prior to striping or marking. Surfaces shall be recleaned, when work has been stopped due to rain.

3.1.1 Cleaning Existing Pavement Markings

In general, markings shall not be placed over existing pavement marking patterns. Existing pavement markings, which are in good condition but interfere or conflict with the newly applied marking patterns, shall be removed. Deteriorated or obscured markings that are not misleading or confusing or interfere with the adhesion of the new marking material do not require removal. New preformed and thermoplastic pavement markings shall not be applied over existing preformed or thermoplastic markings. Whenever grinding, scraping, sandblasting or other operations are performed the work must be conducted in such a manner that the finished pavement surface is not damaged or left in a pattern that is misleading or confusing. When these operations are completed the pavement surface shall be blown off with compressed air to remove residue and debris resulting from the cleaning work.

3.2 APPLICATION

All pavement markings and patterns shall be placed as shown on the plans. The color shall be as indicated. All parking lot markings shall be white applied to a width of 4 inches.

3.2.1 Application

Apply epoxy pavement markings in accordance with the attached specification. Furnish and place epoxy pavement markings together with appropriate glass spheres for reflectorizing the resin.

3.2.2 Spacing and Layout

1. Apply all markings in accordance with plan layout and details.
2. The Contractor shall place necessary "spotting" at appropriate points to provide horizontal control for striping, and determine necessary starting and cutoff points. Skip line intervals will not be marked. Longitudinal joints and pavement edges shall serve as horizontal control when so directed.

A tolerance of 1/8 inch under and 1/2 inch over the specified width will be allowed for striping provided the variance is gradual and does not detract from the general appearance. Skip line segments may vary up to 1/4 foot from the specified lengths provided the over and under variations are reasonably compensatory. Alignment deviations from the control guide shall not exceed 2 inches. Material shall not be applied over a longitudinal joint. Establishment of application tolerances shall not relieve the Contractor of the responsibility to comply as closely as practicable with the planned dimensions.

3.3 PROTECTION OF TRAFFIC AND MARKINGS

Furnish and install all necessary warning and directional signs and devices in order to; maintain traffic whenever pavement markings are applied in the presence of traffic, and to protect uncured markings as needed until traffic can cross markings without damaging markings. When necessary, a pilot car and flaggers shall be used to provide adequate control and direction of traffic.

3.4 MARKING REMOVAL

Pavement marking, including plastic tape, shall be removed in the areas shown on the drawings. Removal of marking shall be as complete as possible without damage to the surface. Aggregate shall not be exposed by the removal process. After the markings are removed, the cleaned pavement surfaces shall exhibit adequate texture for remarking as specified in paragraph SURFACE PREPARATION. Contractor shall demonstrate removal of pavement marking in an area designated by the Contracting Officer. The demonstration area will become the standard for the remainder of the work.

3.4.1 Equipment Operation

Equipment shall be controlled and operated to remove markings from the pavement surface, prevent dilution or removal of binder from underlying

pavement, and prevent emission of blue smoke from asphalt or tar surfaces.

3.4.2 Cleanup and Waste Disposal

The worksite shall be kept clean of debris and waste from the removal operations. Cleanup shall immediately follow removal operations in areas subject to air traffic. Debris shall be disposed of at approved sites.

-- End of Section --

Attachment

Specifications for Epoxy Resin Pavement Markings (Free of Toxic Heavy Metals)

1.0 DESCRIPTION

The work shall consist of furnishing and installing reflectorized white and yellow two-component, 100 percent solids epoxy pavement markings. Applications are lines, legends, symbols, crosswalks and stop lines placed on properly prepared asphaltic and portland cement concrete pavement surfaces in accordance with the Special Provisions, Plans, this Attachment and as directed by the Engineer. Upon curing, the materials produce pavement markings of specified thickness, width and retroreflectivity that resist wear from high traffic volumes for several years. During darkness and weather permitting, yellow markings shall be readily distinguishable from white markings.

Values stated in the International System of Units SI apply only to projects to be constructed in Metric units of measure. Values stated in inch-pound units (in parenthesis) apply only to projects to be constructed in English units of measure.

2.0 QUALIFICATIONS

2.1 Epoxy striping is a technical process requiring specialized equipment, quality controlled materials and well-trained operators to produce functional, long life pavement markings. To minimize application failures, Mn/DOT requires epoxy materials, beads, the pavement marking contractor, and striper to be approved prior to the bidding process.

2.1.1 A pavement marking contractor and/or equipment may be qualified as follows:

1. No previous epoxy striping on any construction contract-- contact Mn/DOT to arrange for field demonstration.
2. Recent epoxy striping experience with other state transportation departments-- contact Mn/DOT and provide experience summary, including names of persons to be contacted.
3. If striper is new, contact Mn/DOT to arrange for field demonstration.

2.1.2 Before any epoxy product is acceptable for bid, it shall be field tested, evaluated, approved and assigned a product identification number by the Mn/DOT Materials Engineering Section. An approved product is placed on the APPROVED PRODUCTS LIST which is shown in Section 2.1.4.

2.1.3 No change in product identification, chemical composition as indicated by infrared spectrophotometry and/or chemical analysis, or changes in the application requirements will be allowed. Any such changes shall be submitted for further evaluation.

Mn/DOT EPOXY PAVEMENT MARKING MATERIAL APPROVED PRODUCTS LIST

2.1.4

<u>Fast Dry (Type I)</u>		
<u>Manufacturer</u>	<u>Product</u>	<u>Appr Date</u>
Polycarb Inc.	MARK 55.3	1998
Epoplex	LS 50	1998

<u>Slow Dry (Type II)</u>		
<u>Manufacturer</u>	<u>Product</u>	<u>Appr Date</u>

Polycarb Inc.
Epoplex

MARK 55
LS 60

1991
1998

3.0 MATERIAL CLASSIFICATIONS

3.1 This specification provides for the classification of epoxy resin pavement marking systems by type.

3.1.1 Type I - A fast cure material suitable for line applications and, under ideal conditions, may not require coning.

3.1.2 Type II - A slow cure material suitable for all applications of pavement markings under controlled traffic conditions, i.e., coning is required and flagging may be as directed by the Engineer.

3.1.2 **Only Slow Dry Type II epoxy material shall be used for epoxy pavement markings except when specified as otherwise in the Special Provisions.**

4.0 EPOXY AND BEAD REQUIREMENTS

4.1 Epoxy Resin Material

4.1.1 The material shall be composed of epoxy resins and pigments only. No solvents are to be given off to the environment upon application to a pavement surface.

4.1.2 The composition shall be within the tolerance permitted for the product tested and approved by Mn/DOT. Type II material shall be completely free of TMPTA (Tri-Methylol Propane Tri-Acrylate) and other multi-functional monomers.

4.1.3 All materials shall be free of lead, cadmium, mercury, hexavalent chromium and other toxic heavy metals as defined by the United States Environmental Protection Agency.

4.1.4 Color -- The color of the white epoxy shall be a pure flat white, free of tints. The color of the yellow epoxy shall closely match Color Number 33538 of Federal Standard 595 and shall conform to the following CIE Chromaticity limits using illuminant "C":

$$\begin{array}{l} x | 0.470 | 0.485 | 0.520 | 0.480 \\ y | 0.440 | 0.460 | 0.450 | 0.420 \end{array}$$

Daylight Directional Reflectance (Y), white, minimum 83

Daylight Directional Reflectance (Y), yellow, minimum 50

Testing will be according to :

Daylight Directional Reflectance
Color

ASTM D 2805
ASTM D 2805

4.1.5 Adhesion Capabilities -- When the adhesion of the material to portland cement concrete (the concrete shall have a minimum of 2,070 kPa (300 psi.) tensile strength) is tested according to American Concrete Institute Committee 403 testing procedure, the failure of the system must take place in the concrete. The concrete shall be 32°C when the material is applied, after which the material shall be allowed to cure for 72 hours at 23±2°C.

4.1.6 Abrasion Resistance -- When the abrasion resistance of the material is tested according to ASTM C 501 with a CS-17 wheel under a load of 1000 grams for 1000 cycles, the wear index shall be no greater than 82. (The wear index is the weight in milligrams that is abraded from the sample under the test conditions).

4.1.7 Hardness -- The Type D durometer hardness of the material shall be not less than 75 nor more than 90 when tested according to ASTM D2240 after the material has cured for 72 hours at 23 ± 2°C.

4.1.8 Tensile Strength -- The tensile strength of the material, when tested according to ASTM D

638, shall not be less than 41,370 kPa (6,000 psi.) after 72 hours cure at $23 \pm 2^\circ\text{C}$.

4.1.9 Compressive Strength -- The compressive strength of the material, when tested according to ASTM D 695, shall not be less than 82,700 kPa (12,000 psi.) after 72 hours cure at $23 \pm 2^\circ\text{C}$.

4.1.10 Shelf Life -- The individual components shall not require mixing prior to use when stored for a period of 12 months.

4.2 Glass Beads

4.2.1 Glass beads shall meet the requirements of AASHTO M247, Type I, and:

- a. Coatings -- the beads shall be treated according to the manufacturers recommendations and meet the requirements of Section 4.4.2 of M247, and
- b. Roundness-- the beads shall have a roundness of at least 80%.

4.2.2 For 380 μm (15 mil) applications, glass beads shall be applied at a rate of at least 3.0 kg/L (25 lb./gal.). **A greater bead application rate may be necessary for meeting the performance criteria (minimum levels of retroreflectivity). This will require contractors to consult with all the material manufacturers.**

4.3 Time to No-Track -- Type I material shall be in "no-tracking" condition in 15 minutes or less and within 45 minutes for Type II material. The "no-tracking" condition shall be determined on an application of specified thickness to the pavement and covered with glass beads at the rate of at least 3.0 kg/L (25 lb./gal.). The lines for this test shall be applied with striping equipment operated so as to have the material at manufacturer's recommended application temperature. This maximum "no-tracking" time shall not be exceeded when the pavement temperature varies from 10 to 49°C (50 to 120°F) and under all humidity conditions, providing the pavement is dry. The no-tracking time shall be determined by passing over the line with a passenger car or pickup truck at a speed of 40 to 55 kmph (25 to 35 mph) in a simulated passing maneuver. A line showing no visual deposition of the material to the pavement surface when viewed from a distance of 15 m (50 ft.) shall be considered as showing "no-tracking" and conforming to this requirement for time to "no-track."

5.0 APPLICATION EQUIPMENT AND PROCEDURES

5.1 Equipment

5.1.1 Equipment furnished shall include an applicator truck of adequate size and power, designed to apply an epoxy resin material and glass beads in a continuous or intermittent line pattern. The equipment shall be capable of placing stripes on the left and right sides. The left carriage shall be capable of placing two lines simultaneously with either line in a solid or intermittent pattern in yellow or white. With change in color usage, an amount of material equal to fifteen 3 m (10 ft.) stripes shall be wasted to eliminate the change of the incorrect color being applied.

5.1.2 The applicator truck (striper) and other vehicles in the striping train shall have permanently mounted Type C flashing arrowboards. They shall be visible to oncoming or following traffic, depending on the type of line being placed. Arrowboard requirements are detailed in the "Field Manual" of the *Minnesota Manual of Traffic Control Devices*. Also, truck equipment shall be capable of accumulating the footage applied per gun, individually each day. Only material application shall activate the footage accumulators. The readout shall be digital and not adjustable.

5.1.3 The equipment shall be capable of applying glass beads in a pressurized system at a rate of at least 3.0 kg/L (25 lb./gal.). **A greater bead application rate may be necessary for meeting the performance criteria (minimum levels of retroreflectivity). This will require contractors to consult with all the material manufacturers.**

5.1.4 All guns on the spray carriages shall be in full view of the operator(s) during operation.

5.1.5 Each crew shall include at least one technical expert knowledgeable in equipment operation, application techniques, control of traffic, and safety regulations.

5.2 Procedures

5.2.1 Pavement markings shall be placed in accordance with the details shown in the Plans and the control points established by the Engineer.

5.2.2 The road surface shall be cleaned at the direction of the Engineer just prior to an application. Pavement cleaning shall consist of at least brushing with a rotary broom (non-metallic), or as

recommended by the material manufacturer and acceptable to the Engineer. New Portland cement concrete surfaces shall be sandblasted clean to remove any surface treatments and/or laitance. On low speed [Speed Limit 65 km/h (40 mph) or less] urban portland cement concrete roadways, sandblast cleaning shall be used for all epoxy pavement markings.

5.2.3 If the roadway surface is dry, the epoxy material application shall immediately follow the pavement cleaning and be preceded by an air blast. However, markings shall not be applied when the wind or other conditions cause a film of dust to be deposited on the pavement surface before the material can be applied.

5.2.4 The Engineer will place necessary spotting at appropriate points as overall horizontal control for striping and to indicate necessary starting and cutoff points. Broken line intervals will not be marked. Longitudinal joints, pavement edges, and existing markings shall serve as control points when so directed.

5.2.5 A 380 μm (15 mil) epoxy line requires a liter of mixed components for every 25.8 m (84.5 ft.) of 100 mm (4 in.) wide line. Field measurements are inserted into the following equation: Line Thickness in micrometers = Liters $\times 0.001 \times 10^{-3} \times \text{m}^3$ divided by the quantity Length in meters \times width in meters (Thickness in inches = Gallons $\times 231$ cubic inches divided by the quantity Length (inches) \times Width (inches)). Use 3.785 liters per gallon if epoxy is metered in gallons.

5.2.6 The minimum line width shall be its nominal width with 6 mm ($\frac{1}{4}$ in.) greater than the nominal width allowed provided the variation is gradual and does not detract from the general appearance. Broken line segments, normally 2 m (6.56 ft.) every 10 m (32.81 ft.), may vary up to 75 mm (3 in.) from the specified lengths provided the over and under variations are reasonably compensatory. Alignment deviations from the control guide shall not exceed , except when approved by the Engineer. Material shall not be applied over a longitudinal joint. Establishment of application tolerances shall not relieve the Contractor of his responsibility to comply as closely as practicable with the planned dimensions.

5.3 Spraying Operation

5.3.1 Placement of epoxy materials shall be permitted only on a clean, dry pavement surface and air and pavement temperatures at least 10° C (50° F) unless the manufacturer, in writing, approves a lower temperature.

5.3.2 Two parts of epoxy component A (pigment) and one part component B (hardener) shall be heated separately at 43° \pm 1° C (110° \pm 30° F) and thoroughly mixed. All material heated over 60° C (140° F) shall be discarded. The sprayed epoxy shall be applied at 43° \pm 1° C (110° \pm 30° F) **or as recommended by the manufacturer.**

5.3.3 Glass beads shall be applied immediately after the placement of the epoxy. If two bead gradations are required by the Special Provisions, two bead dispensers are required to deliver the specified drop rates. Otherwise the dispenser system must deliver at a minimum 3.0 kg (25 lb./gal.) of beads per liter of epoxy material. **A greater bead application rate may be necessary for meeting the performance criteria (minimum levels of retroreflectivity). This will require contractors to consult with all the material manufacturers.**

5.3.4 The Contractor shall cooperate with inspection personnel in reviewing operation of the equipment, safety precautions, measurement of materials (components and beads), computations to determine specific and daily application rates, sampling materials, making other measurements, such as epoxy thickness, and notifications as to work schedule.

5.3.5 **Only Type II epoxy material shall be used for epoxy pavement markings except when specified as otherwise in the Special Provisions.**

5.3.6 Traffic control for the pavement marking operations shall be in substantial conformance with the "Field Manual," *Minnesota Manual of Uniform Traffic Control Devices* . **A shadow vehicle with a truck-mounted attenuator shall be used on high speed [SPEED LIMIT (65 km/h) (40 mph) and greater], high volume (ADT 1500 and greater) highways.**

6.0 SAMPLING RATE & PROCEDURES

6.1 One pint samples of each manufacturer's lot or batch furnished for the contract shall be **submitted to Mn/DOT at the time of manufacturing**. One pint samples of both Part A (yellow/white) & part B must be submitted to the Mn/DOT Materials Laboratory, 1400 Gervais Ave., Maplewood, Minnesota 55109. (612) 779-5550 or 5549, FAX: (612) 779-5616. Samples shall be identified as follows:

- | | |
|----------------------------------|------------------------------------|
| 1. Manufacturer's Name | 5. Color |
| 2. Manufacturer's Product Number | 6. Intended state project numbers. |
| 3. Lot/Batch Number | |
| 4. Date Manufactured | |

6.2 Contractors will not be allowed to use material that has not meet the requirements of Sections 6.1 & 7.0. Contractors will be asked to remove material that does not conform to Sections 6.1 & 7.0 and replace with material that does.

7.0 CERTIFICATIONS

7.1 The manufacturer shall certify that the components meet the requirements of these specifications and are on the Mn/DOT Approved Product List.

7.2 Certifications shall be sent along with the samples in section 6.1.

8.0 CONTAINER MARKINGS

8.1 Containers for epoxy components shall be marked with the manufacturer's name, product identification number, lot or batch number, date of manufacture, color, net weight of contents.

8.2 Containers for glass beads shall be marked with the name of manufacturer, the wording "Glass Beads," lot or batch number, coating type, date manufactured, and the net weight.

9.0 ACCEPTANCE OF PAVEMENT MARKINGS

In order to be a long-life pavement marking, epoxy markings placed in Minnesota must retain a satisfactory level of retroreflectivity in addition to demonstrating good adhesion, resisting chipping, and exhibiting proper daytime and nighttime colors. These attributes have been observed and evaluated for several years and are the basis for acceptance/rejection procedures and values used herein.

9.1 Retroreflectivity

9.1.1 Acceptable Minimum Retroreflectivity Values

MINIMUM AVERAGE RETROREFLECTIVITY VALUES
FOR EPOXY MARKINGS
(mcd/m²/lux)

Period	White	Yellow
Initial*	300	200
After-One-Winter*	175	140

* Described in Section 9.1.4 Miscellaneous Traffic Controls, Numbers 4 and 5.

9.1.2 Retroreflectometers-- Measurements shall be taken with either a portable or mobile retroreflectometer conforming to 30-meter geometry which is defined as: the entrance angle (the angle between the illumination axis and the retroreflector axis) shall fall between 88.50° and 88.76° and the observation angle (the angle between the illumination axis and the observation axis) shall fall between 1.0° and 1.05°; and, the co-viewing angle (the complement of the entrance angle) shall fall between 2.29° and 2.50°. All retroreflectivity

readings and data analysis will be provided by Mn/DOT at no cost to the Contractor.

Mn/DOT reserves the right to:

- make daytime and/or nighttime visual inspections with or without the presence of the Contractor's representative, mainly to locate obvious or suspect areas of deficiency, and
- determine retroreflectivity of symbols, legends and lines wider than 200 mm (8 in.) using the portable retroreflectometer only.

9.1.3 Test Segments -- The following methodology will be used to evaluate retroreflectivity performance of in-service longitudinal line pavement markings:

LENGTH AND NUMBER OF TEST SEGMENTS^a PER ROADWAY^b PER LINE TYPE^c

Length of Roadway	Number of Test Segments	Length of Test Segments
Less than 1.5 km (1 mi.)	1	300 m (0.2 mi.)
Greater than or equal to 1.5 km (1 mi.)	1 per 1.5 km (1 mi.)	300 m (0.2 mi.)

^a **TEST SEGMENTS**-- Areas of a roadway chosen for measuring retroreflectivity of the line types.

^b **ROADWAY**--As used here, means that portion of a street or highway ordinarily used for vehicular traffic. In the event a street or highway includes two or more separate roadways, the term roadway shall refer to each roadway separately.

^c **LINE TYPE**-- Longitudinal lines of the same color and function. For example, white and yellow edge lines are each a line type.

9.1.4 Measurements in Test Segments

Portable Retroreflectometer

1. Take a minimum of 20 readings in each test segment per line type.
2. On broken lines (skip striping), measure every other stripe, taking no more than two readings per stripe with readings 0.5 m (20 in.) from the ends of the marking.
3. For solid lines, divide test segment into ten areas of 30 m (100 ft.); space readings a minimum of 10 m (33 ft.) and a maximum of 30 m (100 ft.) apart.
4. For 10 percent of each message type, take 5 readings on each message line; for 10 percent of each symbol type, take 5 readings on each symbol.
5. Upon completion of the evaluation, regardless of the results, additional test segments may be ordered by the Engineer.

Mobile Retroreflectometer

1. Calibration of the instruments shall be in accordance with the manufacturer's instructions.
2. Retroreflectivity shall be measured at a minimum rate of 20 percent of each roadway length by line type.
3. Should another mobile unit be available, the maximum acceptable deviation for measurements made by the two different instruments of the same manufacturer and for the same roadway length shall be $\pm 10\%$.
4. Repeatability for the given mobile unit shall be $\pm 6\%$.
5. Upon completion of the evaluation, regardless of the results, additional test segments may be ordered by the Engineer.

Miscellaneous Controls

1. Take measurements on a clean, dry roadway.
2. Collect data in direction of traffic flow.
3. Measurement units are: $\text{mcd/m}^2/\text{lux}$.
4. Wait at least two (2) weeks from date of placement of the markings before taking initial readings.
5. Take after-one-winter readings in May or June to assure that spring rains have cleaned the beads.
6. Randomly select test segments unless night reviews or other knowledge supersedes a random selection process.
7. Measure each line type separately.
8. The Engineer may request additional readings or test segments.
9. In the event LASERLUX is not available, the Engineer may require the use of the portable retroreflectometer or establish an alternative evaluation plan.

9.1.5 Contents of Retroreflectivity Report

The report shall consist of:

- State Project number
- Trunk Highway number
- Test date
- Geographical location of the test site(s), including distance from the nearest permanent site identification, such as a reference point.
- Identification of the pavement marking material tested: type, color, age, and transverse location on the road
- Identification of the retroreflectometer
- Remarks concerning the overall condition of the line, messages and symbols such as carryover of asphalt, snow plow damage, uneven distribution of beads, etc.
- Average of the readings for each test segment with one standard deviation calculated.
- Average of the readings for each message and symbol type.

9.2 Correction of Defects/Penalties

1. All pavement markings not conforming to the requirements of the Contract shall be removed and replaced or otherwise repaired to the satisfaction of the Engineer. Removal of unacceptable work shall be accomplished with suitable blasting or grinding equipment unless other means are authorized by the Engineer.
2. Where yield computations show a deficiency in material usage of not more than 20 percent, Mn/DOT may require satisfactory repair or may accept the work at a reduced unit price which is in direct proportion to the percent of the deficiency. Where the deficiency in material usage exceeds 20%, Mn/DOT may require removal and replacement to the satisfaction of the Engineer unless other means are approved by the Engineer.
3. If the Engineer requires removal and replacement, the contractor shall remove (by an approved process) at least 90% of the deficient line, with no excessive scarring of the existing pavement. The removal width shall be one inch wider all around the nominal width of the pavement marking to be removed.
4. Where initial retroreflectivity falls below the minimum acceptable levels but not more than 20%, the Engineer may require satisfactory repair or may accept the work at a reduced unit price which is in direct proportion to the percent of the deficiency. Where the deficiency in retroreflectivity exceeds 20%, i.e., less than $240 \text{ mcd/m}^2/\text{lux}$ for white and $160 \text{ mcd/m}^2/\text{lux}$ for yellow, the Engineer may require the removal and replacement to the satisfaction of the Engineer unless other means are approved by the Engineer. Where minimum levels after one winter fall below the specified levels

(170 mcd/m²/lux - 135 mcd/m²/lux), Mn/DOT will notify the project contractor and manufacturer(s) of the failure. If the initial readings were above Mn/DOT's specified initial minimum levels (300 mcd/m²/lux - 200 mcd/m²/lux), the Engineer, contractor, and manufacturer(s) of the material(s) shall review the project together. Based on the review an of all known aspects, the Engineer will make a determination as to why the job failed and notify the Contractor, pavement marking contractor, and/or manufacturer(s) in writing.

5. If this process has to be repeated on several projects with either the same contractor and/or manufacturer(s), Mn/DOT will take corrective action. This corrective action will be a two step process:

Step 1 Pavement marking contractor/manufacturer(s) will be considered not approved for Mn/DOT projects, except to bring workmanship/product back into compliance.

Step 2 If the first step cannot be attained, pavement marking contractor/manufacturer(s) will not be allowed to participate in Mn/DOT projects and/or be removed from Approved Product List.

10.0 DOCUMENTATION

Contractors applying epoxy pavement markings for Mn/DOT under a contract **are required** to fill out the attached "Construction Striper Operations Daily Log" form. These forms shall be completed at the end of each project and faxed to the "Reflective Systems Unit" at (612) 797-3181 Attn: Jim Carlson. **Failure to submit completed forms may result in 10% of the overall contract price for epoxy pavement markings held back.** Also, if forms are not sent in to the reflective systems unit in a timely manner projects will not be inspected during optimum times for meeting their performance criteria. Any questions regarding this form can be answered by calling the Reflective Systems Unit at (612) 797-3183.

Construction Striper Operations Daily Log

Contract Striper Operations Daily Log [X] [] []

Date: [] SP Number: [] Contractor: [] Record 0 of 0

Equipment Numbers	Material	Supplier	Lot No.	Inspector/Supv.	Reg Hrs	O.T. Hrs
Striper: []	Tape	[]	[]	[]	[]	[]
Nurse: []	Epoxy I	[]	[]	[]	[]	[]
Traffic 1: []	Epoxy II	[]	[]	[]	[]	[]
Traffic 2: []	Thermo	[]	[]	[]	[]	[]
Aux Unit: []	Beads	[]	[]	[]	[]	[]

Material(s) [] Begin Added End Net [] Begin Added End Net []

Beads [] Pounds []

Segment of 0 County: [] City: [] District: []

R	S	Hwy	Begin Ref Pnt	End Ref Pnt	Int sect	Int chg	Material	C	Trav Time	Equip Delay	Wthr Delay	Work Types

A: White Edge B: Yellow Edge C: White Skip D: Yellow Ch. E: 8" White Gore F: 8" Yellow Gore
 G: Messages H: Stop Bars I: Cross walk M: Other Work N: Only Intersections/Interchanges

Buttons: Help, Memo, Default, Save, Undo, Exit, Locate, [H], [H], Download

SECTION TABLE OF CONTENTS

DIVISION 02 - SITE WORK

SECTION 02770

CONCRETE SIDEWALKS, CURBS AND GUTTERS

04/01

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 SUBMITTALS
- 1.3 WEATHER LIMITATIONS
 - 1.3.1 Placing During Cold Weather
 - 1.3.2 Placing During Warm Weather
- 1.4 PLANT, EQUIPMENT, MACHINES, AND TOOLS
 - 1.4.1 General Requirements
 - 1.4.2 Slip Form Equipment

PART 2 PRODUCTS

- 2.1 CONCRETE
 - 2.1.1 Air Content
 - 2.1.2 Slump
 - 2.1.3 Reinforcement Steel
- 2.2 CONCRETE CURING MATERIALS
 - 2.2.1 Impervious Sheet Materials
 - 2.2.2 Burlap
 - 2.2.3 White Pigmented Membrane-Forming Curing Compound
- 2.3 CONCRETE PROTECTION MATERIALS
- 2.4 JOINT FILLER STRIPS
 - 2.4.1 Expansion Joint Filler, Premolded
- 2.5 JOINT SEALANTS
 - 2.5.1 Joint Sealant, Cold-Applied
 - 2.5.2 Joint Sealant, Hot-Poured
- 2.6 FORM WORK
 - 2.6.1 Sidewalk Forms
 - 2.6.2 Curb and Gutter Forms

PART 3 EXECUTION

- 3.1 SUBGRADE PREPARATION
 - 3.1.1 Sidewalk Subgrade
 - 3.1.2 Curb and Gutter Subgrade
 - 3.1.3 Maintenance of Subgrade
- 3.2 FORM SETTING
 - 3.2.1 Sidewalks
 - 3.2.2 Curbs and Gutters
- 3.3 SIDEWALK CONCRETE PLACEMENT AND FINISHING

- 3.3.1 Formed Sidewalks
- 3.3.2 Concrete Finishing
- 3.3.3 Edge and Joint Finishing
- 3.3.4 Surface and Thickness Tolerances
- 3.4 CURB AND GUTTER CONCRETE PLACEMENT AND FINISHING
 - 3.4.1 Formed Curb and Gutter
 - 3.4.2 Curb and Gutter Finishing
 - 3.4.3 Concrete Finishing
 - 3.4.4 Joint Finishing
 - 3.4.5 Surface and Thickness Tolerances
- 3.5 SIDEWALK JOINTS
 - 3.5.1 Sidewalk Contraction Joints
 - 3.5.2 Sidewalk Expansion Joints
 - 3.5.3 Reinforcement Steel Placement
- 3.6 CURB AND GUTTER JOINTS
 - 3.6.1 Contraction Joints
 - 3.6.2 Expansion Joints
- 3.7 CURING AND PROTECTION
 - 3.7.1 General Requirements
 - 3.7.1.1 Mat Method
 - 3.7.1.2 Impervious Sheeting Method
 - 3.7.1.3 Membrane Curing Method
 - 3.7.2 Backfilling
 - 3.7.3 Protection
 - 3.7.4 Protective Coating
 - 3.7.4.1 Application
 - 3.7.4.2 Precautions
- 3.8 FIELD QUALITY CONTROL
 - 3.8.1 General Requirements
 - 3.8.2 Concrete Testing
 - 3.8.2.1 Strength Testing
 - 3.8.2.2 Air Content
 - 3.8.2.3 Slump Test
 - 3.8.3 Thickness Evaluation
 - 3.8.4 Surface Evaluation
- 3.9 SURFACE DEFICIENCIES AND CORRECTIONS
 - 3.9.1 Thickness Deficiency
 - 3.9.2 High Areas
 - 3.9.3 Appearance

-- End of Section Table of Contents --

SECTION 02770

CONCRETE SIDEWALKS, CURBS AND GUTTERS

04/01

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS
(AASHTO)

AASHTO M 182 (1991) Burlap Cloth Made from Jute or Kenaf

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 185 (1997) Steel Welded Wire Fabric, Plain,
for Concrete Reinforcement

ASTM A 615 (1996a) Deformed and Plain Billet-Steel
Bars for Concrete Reinforcement

ASTM A 616 (1996a) Rail-Steel Deformed and Plain Bars
for Concrete Reinforcement

ASTM A 617 (1996a) Axle-Steel Deformed and Plain Bars
for Concrete Reinforcement

ASTM C 31 (1996) Making and Curing Concrete Test
Specimens in the Field

ASTM C 143 (1990a) Slump of Hydraulic Cement Concrete

ASTM C 171 (1997) Sheet Materials for Curing Concrete

ASTM C 172 (1997) Sampling Freshly Mixed Concrete

ASTM C 173 (1996) Air Content of Freshly Mixed
Concrete by the Volumetric Method

ASTM C 231 (1997) Air Content of Freshly Mixed
Concrete by the Pressure Method

ASTM C 309 (1997) Liquid Membrane-Forming Compounds
for Curing Concrete

ASTM C 920	(1995) Elastomeric Joint Sealants
ASTM D 1751	(1983; R 1991) Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
ASTM D 1752	(1984; R 1996) Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction
ASTM D 3405	(1996) Joint Sealants, Hot-Applied, for Concrete and Asphalt Pavements

1995 MINNESOTA DEPARTMENT OF TRANSPORTATION STANDARD
SPECIFICATIONS FOR CONSTRUCTION (MNDOT STANDARD SPECIFICATIONS)

MNDOT 2461	Structural Concrete
MNDOT 2521	Walks
MNDOT 2531	Concrete Curbing

1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having a "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-07 Schedules

Concrete placement schedule; FIO

Provide schedule at least 7 days prior to start of placement.

SD-09 Reports

Concrete Mixture Proportions; GA.

At least ten days prior to placement of concrete, the Contractor shall submit the mixture proportions that meet requirements specified in the MNDOT Standard specifications and that will produce concrete of the quality required. Applicable test reports shall be submitted to verify that the concrete mixture proportions meet requirements specified in the MNDOT Standard specifications and will produce concrete of the quality specified.

Testing; FIO.

Copies of all test reports within 24 hours of completion of the test.

SD-18 Records

Concrete; FIO.

Copies of certified delivery tickets for all concrete used in the construction.

1.3 WEATHER LIMITATIONS

1.3.1 Placing During Cold Weather

Concrete placement shall not take place when the air temperature reaches 40 degrees F and is falling, or is already below that point. Placement may begin when the air temperature reaches 35 degrees F and is rising, or is already above 40 degrees F. Provisions shall be made to protect the concrete from freezing during the specified curing period. If necessary to place concrete when the temperature of the air, aggregates, or water is below 35 degrees F, placement and protection shall be approved in writing. Approval will be contingent upon full conformance with the following provisions. The underlying material shall be prepared and protected so that it is entirely free of frost when the concrete is deposited. Mixing water and aggregates shall be heated as necessary to result in the temperature of the in-place concrete being between 50 and 85 degrees F. Methods and equipment for heating shall be approved. The aggregates shall be free of ice, snow, and frozen lumps before entering the mixer. Covering and other means shall be provided for maintaining the concrete at a temperature of at least 50 degrees F for not less than 72 hours after placing, and at a temperature above freezing for the remainder of the curing period.

1.3.2 Placing During Warm Weather

The temperature of the concrete as placed shall not exceed 85 degrees F except where an approved retarder is used. The mixing water and/or aggregates shall be cooled, if necessary, to maintain a satisfactory placing temperature. The placing temperature shall not exceed 95 degrees F at any time.

1.4 PLANT, EQUIPMENT, MACHINES, AND TOOLS

1.4.1 General Requirements

Plant, equipment, machines, and tools used in the work shall be subject to approval and shall be maintained in a satisfactory working condition at all times. The equipment shall have the capability of producing the required product, meeting grade controls, thickness control and smoothness requirements as specified. Use of the equipment shall be discontinued if it produces unsatisfactory results. The Contracting Officer shall have access at all times to the plant and equipment to ensure proper operation and compliance with specifications.

1.4.2 Slip Form Equipment

Slip form paver or curb forming machine, will be approved based on trial use on the job and shall be self-propelled, automatically controlled, crawler mounted, and capable of spreading, consolidating, and shaping the plastic concrete to the desired cross section in 1 pass.

PART 2 PRODUCTS

2.1 CONCRETE

Concrete shall conform to the applicable requirements of MNDOT 2461, MNDOT 2521, and MNDOT 2531 except as otherwise specified.

2.1.1 Air Content

Mixtures shall have air content by volume of concrete of 5 to 7 percent, based on measurements made immediately after discharge from the mixer.

2.1.2 Slump

The concrete slump shall be as required by MNDOT 2521 for sidewalks and MNDOT 2531 for curb and gutter as applicable to the method of placement.

2.1.3 Reinforcement Steel

Reinforcement bars shall conform to ASTM A 615, ASTM A 616, or ASTM A 617. Wire mesh reinforcement shall conform to ASTM A 185.

2.2 CONCRETE CURING MATERIALS

2.2.1 Impervious Sheet Materials

Impervious sheet materials shall conform to ASTM C 171, type optional, except that polyethylene film, if used, shall be white opaque.

2.2.2 Burlap

Burlap shall conform to AASHTO M 182 for Class 3.

2.2.3 White Pigmented Membrane-Forming Curing Compound

White pigmented membrane-forming curing compound shall conform to ASTM C 309, Type 2, Class B.

2.3 CONCRETE PROTECTION MATERIALS

Concrete protection materials shall be a linseed oil mixture of equal parts, by volume, of linseed oil and either mineral spirits, naphtha, or turpentine. At the option of the contractor, commercially prepared linseed oil mixtures, formulated specifically for application to concrete to provide protection against the action of deicing chemicals may be used, except that emulsified mixtures are not acceptable.

2.4 JOINT FILLER STRIPS

2.4.1 Expansion Joint Filler, Premolded

Expansion joint filler, premolded, shall conform to ASTM D 1751 or ASTM D 1752, 1/2 inch thick, unless otherwise indicated.

2.5 JOINT SEALANTS

2.5.1 Joint Sealant, Cold-Applied

Joint sealant, cold-applied shall conform to ASTM C 920.

2.5.2 Joint Sealant, Hot-Poured

Joint sealant, hot-poured shall conform to ASTM D 3405.

2.6 FORM WORK

Form work shall be designed and constructed to ensure that the finished concrete will conform accurately to the indicated dimensions, lines, and elevations, and within the tolerances specified. Forms shall be of wood or steel, straight, of sufficient strength to resist springing during depositing and consolidating concrete. Wood forms shall be surfaced plank, 2 inches nominal thickness, straight and free from warp, twist, loose knots, splits or other defects. Wood forms shall have a nominal length of 10 feet. Radius bends may be formed with 3/4 inch boards, laminated to the required thickness. Steel forms shall be channel-formed sections with a flat top surface and with welded braces at each end and at not less than two intermediate points. Ends of steel forms shall be interlocking and self-aligning. Steel forms shall include flexible forms for radius forming, corner forms, form spreaders, and fillers. Steel forms shall have a nominal length of 10 feet with a minimum of 3 welded stake pockets per form. Stake pins shall be solid steel rods with chamfered heads and pointed tips designed for use with steel forms.

2.6.1 Sidewalk Forms

Sidewalk forms shall be of a height equal to the full depth of the finished sidewalk.

2.6.2 Curb and Gutter Forms

Curb and gutter outside forms shall have a height equal to the full depth of the curb or gutter. The inside form of curb shall have batter as indicated and shall be securely fastened to and supported by the outside form. Rigid forms shall be provided for curb returns, except that benders or thin plank forms may be used for curb or curb returns with a radius of 10 feet or more, where grade changes occur in the return, or where the central angle is such that a rigid form with a central angle of 90 degrees cannot be used. Back forms for curb returns may be made of 1-1/2 inch benders, for the full height of the curb, cleated together. In lieu of inside forms for curbs, a curb "mule" may be used for forming and finishing this surface, provided the results are approved.

PART 3 EXECUTION

3.1 SUBGRADE PREPARATION

The subgrade shall be constructed to the specified grade and cross section

prior to concrete placement. Subgrade shall be placed and compacted in conformance with SECTION 02722: AGGREGATE BASE OR SURFACE COURSE.

3.1.1 Sidewalk Subgrade

The subgrade shall be tested for grade and cross section with a template extending the full width of the sidewalk and supported between side forms.

3.1.2 Curb and Gutter Subgrade

The subgrade shall be tested for grade and cross section by means of a template extending the full width of the curb and gutter. The subgrade shall be of materials equal in bearing quality to the subgrade under the adjacent pavement.

3.1.3 Maintenance of Subgrade

The subgrade shall be maintained in a smooth, compacted condition in conformity with the required section and established grade until the concrete is placed. The subgrade shall be in a moist condition when concrete is placed. The subgrade shall be prepared and protected to produce a subgrade free from frost when the concrete is deposited.

3.2 FORM SETTING

Forms shall be set to the indicated alignment, grade and dimensions. Forms shall be held rigidly in place by a minimum of 3 stakes per form placed at intervals not to exceed 4 feet. Corners, deep sections, and radius bends shall have additional stakes and braces, as required. Clamps, spreaders, and braces shall be used where required to ensure rigidity in the forms. Forms shall be removed without injuring the concrete. Bars or heavy tools shall not be used against the concrete in removing the forms. Any concrete found defective after form removal shall be promptly and satisfactorily repaired. Forms shall be cleaned and coated with form oil each time before concrete is placed. Wood forms may, instead, be thoroughly wetted with water before concrete is placed, except that with probable freezing temperatures, oiling is mandatory.

3.2.1 Sidewalks

Forms for sidewalks shall be set with the upper edge true to line and grade with an allowable tolerance of 1/8 inch in any 10 foot long section. After forms are set, grade and alignment shall be checked with a 10 foot straightedge. Forms shall have a transverse slope as indicated with the low side adjacent to the roadway. Side forms shall not be removed for 12 hours after finishing has been completed.

3.2.2 Curbs and Gutters

The forms of the front of the curb shall be removed not less than 2 hours nor more than 6 hours after the concrete has been placed. Forms back of curb shall remain in place until the face and top of the curb have been finished, as specified for concrete finishing. Gutter forms shall not be removed while the concrete is sufficiently plastic to slump in any

direction.

3.3 SIDEWALK CONCRETE PLACEMENT AND FINISHING

3.3.1 Formed Sidewalks

Concrete shall be placed in the forms in one layer. When consolidated and finished, the sidewalks shall be of the thickness indicated. After concrete has been placed in the forms, a strike-off guided by side forms shall be used to bring the surface to proper section to be compacted. The concrete shall be consolidated with an approved vibrator, and the surface shall be finished to grade with a strike off.

3.3.2 Concrete Finishing

After straightedging, when most of the water sheen has disappeared, and just before the concrete hardens, the surface shall be finished with a wood float or darby to a smooth and uniformly fine granular or sandy texture free of waves, irregularities, or tool marks. A scored surface shall be produced by brooming with a fiber-bristle brush in a direction transverse to that of the traffic, followed by edging.

3.3.3 Edge and Joint Finishing

All slab edges, including those at formed joints, shall be finished with an edger having a radius of 1/8 inch. Transverse joint shall be edged before brooming, and the brooming shall eliminate the flat surface left by the surface face of the edger. Corners and edges which have crumbled and areas which lack sufficient mortar for proper finishing shall be cleaned and filled solidly with a properly proportioned mortar mixture and then finished.

3.3.4 Surface and Thickness Tolerances

Finished surfaces shall not vary more than 5/16 inch from the testing edge of a 10-foot straightedge. Permissible deficiency in section thickness will be up to 1/4 inch.

3.4 CURB AND GUTTER CONCRETE PLACEMENT AND FINISHING

3.4.1 Formed Curb and Gutter

Concrete shall be placed to the section required in a single lift. Consolidation shall be achieved by using approved mechanical vibrators. Curve shaped gutters shall be finished with a standard curb "mule".

3.4.2 Curb and Gutter Finishing

Approved slipformed curb and gutter machines may be used in lieu of hand placement.

3.4.3 Concrete Finishing

Exposed surfaces shall be floated and finished with a smooth wood float

until true to grade and section and uniform in texture. Floated surfaces shall then be brushed with a fine-hair brush with longitudinal strokes. The edges of the gutter and top of the curb shall be rounded with an edging tool to a radius of 1/2 inch. Immediately after removing the front curb form, the face of the curb shall be rubbed with a wood or concrete rubbing block and water until blemishes, form marks, and tool marks have been removed. The front curb surface, while still wet, shall be brushed in the same manner as the gutter and curb top. The top surface of gutter and entrance shall be finished to grade with a wood float.

3.4.4 Joint Finishing

Curb edges at formed joints shall be finished as indicated.

3.4.5 Surface and Thickness Tolerances

Finished surfaces shall not vary more than 1/4 inch from the testing edge of a 10-foot straightedge. Permissible deficiency in section thickness will be up to 1/4 inch.

3.5 SIDEWALK JOINTS

Sidewalk joints shall be constructed to divide the surface into rectangular areas. Transverse contraction joints shall be spaced at a distance equal to the sidewalk width or 5 feet on centers, whichever is less, and shall be continuous across the slab. Longitudinal contraction joints shall be constructed along the centerline of all sidewalks 10 feet or more in width.

Transverse expansion joints shall be installed every 50 feet or less and at sidewalk returns and opposite expansion joints in adjoining curbs. Where the sidewalk is not in contact with the curb, transverse expansion joints shall be installed as indicated. Expansion joints shall be formed about structures and features which project through or into the sidewalk pavement, using joint filler of the type, thickness, and width indicated.

3.5.1 Sidewalk Contraction Joints

The contraction joints shall be formed in the fresh concrete by cutting a groove in the top portion of the slab to a depth of at least one-third of the sidewalk slab thickness, using a jointer to cut the groove, or by sawing a groove in the hardened concrete with a power-driven saw, unless otherwise approved. Sawed joints shall be constructed by sawing a groove in the concrete with a 1/8 inch blade to the depth indicated. An ample supply of saw blades shall be available on the job before concrete placement is started, and at least one standby sawing unit in good working order shall be available at the jobsite at all times during the sawing operations.

3.5.2 Sidewalk Expansion Joints

Expansion joints shall be formed with 1/2 inch joint filler strips for the full depth of the sidewalk. Joint filler shall be placed with top edge 1/4 inch below the surface and shall be held in place with steel pins or other devices to prevent warping of the filler during floating and finishing. Immediately after finishing operations are completed, joint edges shall be

rounded with an edging tool having a radius of 1/8 inch, and concrete over the joint filler shall be removed. At the end of the curing period, expansion joints shall be cleaned and filled with joint sealant where adjacent to structures. The joint opening shall be thoroughly cleaned before the sealing material is placed. Sealing material shall not be spilled on exposed surfaces of the concrete. Concrete at the joint shall be surface dry and atmospheric and concrete temperatures shall be above 50 degrees F at the time of application of joint sealing material. Excess material on exposed surfaces of the concrete shall be removed immediately and concrete surfaces cleaned.

3.5.3 Reinforcement Steel Placement

Reinforcement steel shall be accurately and securely fastened in place with suitable supports and ties before the concrete is placed.

3.6 CURB AND GUTTER JOINTS

Curb and gutter joints shall be constructed at right angles to the line of curb and gutter.

3.6.1 Contraction Joints

Contraction joints shall be constructed directly opposite contraction joints in abutting portland cement concrete pavements and spaced so that monolithic sections between curb returns will not be less than 5 feet nor greater than 15 feet in length.

3.6.2 Expansion Joints

Expansion joints shall be formed by means of preformed expansion joint filler material cut and shaped to the cross section of curb and gutter full depth. Expansion joints shall be provided in curb and gutter directly opposite expansion joints of abutting portland cement concrete pavement or other in place fixed objects, and shall be of the same type and thickness as joints in the pavement. Where curb and gutter do not abut portland cement concrete pavement, expansion joints at least 1/2 inch in width shall be provided.

3.7 CURING AND PROTECTION

3.7.1 General Requirements

Concrete shall be protected against loss of moisture and rapid temperature changes for at least 7 days from the beginning of the curing operation. Unhardened concrete shall be protected from rain and flowing water. All equipment needed for adequate curing and protection of the concrete shall be on hand and ready for use before actual concrete placement begins. Protection shall be provided as necessary to prevent cracking of the pavement due to temperature changes during the curing period.

3.7.1.1 Mat Method

The entire exposed surface shall be covered with 2 or more layers of

burlap. Mats shall overlap each other at least 6 inches. The mat shall be thoroughly wetted with water prior to placing on concrete surface and shall be kept continuously in a saturated condition and in intimate contact with concrete for not less than 7 days.

3.7.1.2 Impervious Sheeting Method

The entire exposed surface shall be wetted with a fine spray of water and then covered with impervious sheeting material. Sheets shall be laid directly on the concrete surface with the light-colored side up and overlapped 12 inches when a continuous sheet is not used. The curing medium shall not be less than 18-inches wider than the concrete surface to be cured, and shall be securely weighted down by heavy wood planks, or a bank of moist earth placed along edges and laps in the sheets. Sheets shall be satisfactorily repaired or replaced if torn or otherwise damaged during curing. The curing medium shall remain on the concrete surface to be cured for not less than 7 days.

3.7.1.3 Membrane Curing Method

A uniform coating of white-pigmented membrane-curing compound shall be applied to the entire exposed surface of the concrete as soon after finishing as the free water has disappeared from the finished surface. Formed surfaces shall be coated immediately after the forms are removed and in no case longer than 1 hour after the removal of forms. Concrete shall not be allowed to dry before the application of the membrane. If any drying has occurred, the surface of the concrete shall be moistened with a fine spray of water and the curing compound applied as soon as the free water disappears. Curing compound shall be applied in two coats by hand-operated pressure sprayers at a coverage of approximately 200 square feet per gallon for the total of both coats. The second coat shall be applied in a direction approximately at right angles to the direction of application of the first coat. The compound shall form a uniform, continuous, coherent film that will not check, crack, or peel and shall be free from pinholes or other imperfections. If pinholes, abrasion, or other discontinuities exist, an additional coat shall be applied to the affected areas within 30 minutes. Concrete surfaces that are subjected to heavy rainfall within 3 hours after the curing compound has been applied shall be resprayed by the method and at the coverage specified above. Areas where the curing compound is damaged by subsequent construction operations within the curing period shall be resprayed. Necessary precautions shall be taken to insure that the concrete is properly cured at sawed joints, and that no curing compound enters the joints. The top of the joint opening and the joint groove at exposed edges shall be tightly sealed before the concrete in the region of the joint is resprayed with curing compound. The method used for sealing the joint groove shall prevent loss of moisture from the joint during the entire specified curing period. Approved standby facilities for curing concrete pavement shall be provided at a location accessible to the jobsite for use in the event of mechanical failure of the spraying equipment or other conditions that might prevent correct application of the membrane-curing compound at the proper time. Concrete surfaces to which membrane-curing compounds have been applied shall be adequately protected during the entire curing period from pedestrian and vehicular traffic, except as required for joint-sawing operations and

surface tests, and from any other possible damage to the continuity of the membrane.

3.7.2 Backfilling

After curing, debris shall be removed and the area adjoining the concrete shall be backfilled, graded, and compacted to conform to the surrounding area in accordance with lines and grades indicated.

3.7.3 Protection

Completed concrete shall be protected from damage until accepted. The Contractor shall repair damaged concrete and clean concrete discolored during construction. Concrete that is damaged shall be removed and reconstructed for the entire length between regularly scheduled joints. Refinishing the damaged portion will not be acceptable. Removed damaged portions shall be disposed of as directed.

3.7.4 Protective Coating

Protective coating of linseed oil mixture shall be applied to the exposed-to-view concrete surface to protect concrete placed during cold weather.

3.7.4.1 Application

Curing and backfilling operation shall be completed prior to applying two coats of protective coating. Concrete shall be surface dry and clean before each application. Coverage shall be by spray application at not more than 50 square yards per gallon for first application and not more than 70 square yards per gallon for second application, except that the number of applications and coverage for each application for commercially prepared mixture shall be in accordance with the manufacturer's instructions. Coated surfaces shall be protected from vehicular and pedestrian traffic until dry.

3.7.4.2 Precautions

Protective coating shall not be heated by direct application of flame or electrical heaters and shall be protected from exposure to open flame, sparks, and fire adjacent to open containers or applicators. Material shall not be applied at ambient or material temperatures lower than 50 degrees F.

3.8 FIELD QUALITY CONTROL

3.8.1 General Requirements

The Contractor shall perform the inspection and tests described and meet the specified requirements for inspection details and frequency of testing.

Based upon the results of these inspections and tests, the Contractor shall take the action and submit reports as required below, and any additional tests to insure that the requirements of these specifications are met.

3.8.2 Concrete Testing

3.8.2.1 Strength Testing

The Contractor shall provide molded concrete specimens for strength tests. Samples of concrete placed each day shall be taken not less than once a day nor less than once for every 50 cubic yards of concrete. The samples for strength tests shall be taken in accordance with ASTM C 172. Cylinders for acceptance shall be molded in conformance with ASTM C 31 by an approved testing laboratory. Each strength test result shall be the average of 2 test cylinders from the same concrete sample tested at 28 days, unless otherwise specified or approved. Concrete specified on the basis of compressive strength will be considered satisfactory if the averages of all sets of three consecutive strength test results equal or exceed the specified strength, and no individual strength test result falls below the specified strength by more than 500 psi.

3.8.2.2 Air Content

Air content shall be determined in accordance with ASTM C 173 or ASTM C 231.

ASTM C 231 shall be used with concretes and mortars made with relatively dense natural aggregates. Two tests for air content shall be made on randomly selected batches of each class of concrete placed during each shift. Additional tests shall be made when excessive variation in concrete workability is reported by the placing foreman or the Government inspector.

If results are out of tolerance, the placing foreman shall be notified and he shall take appropriate action to have the air content corrected at the plant. Additional tests for air content will be performed on each truckload of material until such time as the air content is within the tolerance specified.

3.8.2.3 Slump Test

Two slump tests shall be made on randomly selected batches of each class of concrete for every 50 cubic yards, or fraction thereof, of concrete placed during each shift. Additional tests shall be performed when excessive variation in the workability of the concrete is noted or when excessive crumbling or slumping is noted along the edges of slip-formed concrete.

3.8.3 Thickness Evaluation

The anticipated thickness of the concrete shall be determined prior to placement by passing a template through the formed section or by measuring the depth of opening of the extrusion template of the curb forming machine.

If a slip form paver is used for sidewalk placement, the subgrade shall be true to grade prior to concrete placement and the thickness will be determined by measuring each edge of the completed slab.

3.8.4 Surface Evaluation

The finished surface of each category of the completed work shall be uniform in color and free of blemishes and form or tool marks.

3.9 SURFACE DEFICIENCIES AND CORRECTIONS

3.9.1 Thickness Deficiency

When measurements indicate that the completed concrete section is deficient in thickness by more than 1/4 inch the deficient section will be removed, between regularly scheduled joints, and replaced.

3.9.2 High Areas

In areas not meeting surface smoothness and plan grade requirements, high areas shall be reduced either by rubbing the freshly finished concrete with carborundum brick and water when the concrete is less than 36 hours old or by grinding the hardened concrete with an approved surface grinding machine after the concrete is 36 hours old or more. The area corrected by grinding the surface of the hardened concrete shall not exceed 5 percent of the area of any integral slab, and the depth of grinding shall not exceed 1/4 inch. Areas requiring grade or surface smoothness corrections in excess of the limits specified above shall be removed and replaced.

3.9.3 Appearance

Exposed surfaces of the finished work will be inspected by the Government and any deficiencies in appearance will be identified. Areas which exhibit excessive cracking, discoloration, form marks, or tool marks or which are otherwise inconsistent with the overall appearances of the work shall be removed and replaced.

-- End of Section --

SECTION TABLE OF CONTENTS

DIVISION 02 - SITE WORK

SECTION 02791

PLAYGROUND PROTECTIVE SURFACING

04/01

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 DEFINITIONS
 - 1.2.1 Critical Height
 - 1.2.2 Designated Play Surface
 - 1.2.3 Head Injury Criteria (HIC)
 - 1.2.4 Impact Attenuation
 - 1.2.5 Loose Fill
 - 1.2.6 Maximum Equipment Height
 - 1.2.7 Play Event
- 1.3 CHILD SAFETY AND ACCESSIBILITY STANDARDS
 - 1.3.1 CHILD SAFETY
 - 1.3.2 CHILD ACCESSIBILITY
- 1.4 SUBMITTALS
- 1.5 DELIVERY, STORAGE, AND HANDLING
- 1.6 INSPECTION
- 1.7 MANUFACTURER'S QUALIFICATION
- 1.8 INSTALLER'S QUALIFICATION
- 1.9 WARRANTY
- 1.10 TECHNICAL REPRESENTATIVE
 - 1.10.1 Playground Areas
- 1.11 MANUFACTURER'S REPRESENTATIVE

PART 2 PRODUCTS

- 2.1 MATERIALS
- 2.2 SYNTHETIC SURFACING
 - 2.2.1 Subbase
 - 2.2.2 Wood Fiber Surfacing
 - 2.2.3 Containment Curbs
 - 2.2.3.1 Border Material
- 2.3 GEOTEXTILE FABRIC
- 2.4 RECYCLED PLASTIC
 - 2.4.1 High Density Polyethylene
 - 2.4.2 Structural Component
- 2.5 CURBS
 - 2.5.1 Concrete Curb

PART 3 EXECUTION

- 3.1 SITE PREPARATION

- 3.1.1 Finished Grade and Underground Utilities
- 3.1.2 Layout
 - 3.1.2.1 Use Zone
 - 3.1.2.2 Shop Drawings
- 3.1.3 Obstructions Below Ground
- 3.1.4 Percolation Test
- 3.1.5 Substitution
- 3.1.6 Subgrade
- 3.1.7 Subsurface
- 3.1.8 Subbase
- 3.1.9 Fall Height
 - 3.1.9.1 General Requirements
 - 3.1.9.2 Measuring Fall Height
- 3.2 RESTORATION AND CLEAN UP
 - 3.2.1 Clean Up
 - 3.2.2 Protection
 - 3.2.3 Disposal of Materials
- 3.3 PROTECTIVE SURFACING ACCEPTANCE
 - 3.3.1 Child Safety and Accessibility Evaluation
 - 3.3.2 Maintenance Instruction
- 3.4 RE-INSTALLATION

-- End of Section Table of Contents --

SECTION 02791

PLAYGROUND PROTECTIVE SURFACING
04/01

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 136	(1996a) Sieve Analysis of Fine and Coarse Aggregates
ASTM D 412	(1998a) Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers - Tension
ASTM D 648	(1997) Deflection Temperature of Plastics Under Flexural Load
ASTM D 1557	(1991) Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft.lbf/cu ft (2,700 Kn-m/cu m))
ASTM D 2047	(1993) Static Coefficient of Friction of Polish-Coated Floor Surfaces as Measured by the James Machine
ASTM D 2261	(1996) Tearing Strength of Fabrics by the Tongue (Single Rip) Procedure (Constant rate-of-extension tensile testing method)
ASTM D 6112	(1997) Compressive and Flexural Creep and Creep-Rupture of Plastic Lumber and Shapes
ASTM F 1015	(1986; R 1995) Relative Abrasiveness of Synthetic Turf Playing Surfaces
ASTM F 1292	(1996) Impact Attenuation of Surface Systems Under and Around Playground Equipment
ASTM F 1487	(1997c) Standard Consumer Safety Performance Specification for Playground

Equipment for Public Use

ASTM PS 83

(1997) Determination of Accessibility of
Surface Systems Under and Around
Playground Equipment

CONSUMER PRODUCT SAFETY COMMISSION (CPSC)

CPSC Pub No 325

(1994) Handbook for Public Playground
Safety

1.2 DEFINITIONS

1.2.1 Critical Height

Critical Height: The fall height at which the protective surfacing meets the requirements of ASTM F 1292.

1.2.2 Designated Play Surface

Designated Play Surface: Any elevated surface for standing, walking, sitting, or climbing; or a flat surface a minimum 2 inches wide having up to a maximum 30 degree angle from horizontal. In some play events the platform surface will be the same as the designated play surface. However, the terms should not be interchanged as they do not define the same point of measurement according to ASTM F 1487.

1.2.3 Head Injury Criteria (HIC)

Head Injury Criteria (HIC): A measure of impact severity that considers the duration over which the most critical section of the deceleration pulse persists as well as the peak level of that deceleration. Head impact injuries are not believed to be life threatening if the HIC does not exceed a value of 1,000.

1.2.4 Impact Attenuation

Impact Attenuation: The ability of protective surfacing to reduce and dissipate the energy of an impacting body.

1.2.5 Loose Fill

Loose Fill: Consisting of small independent movable components such as sand, gravel, or wood chip. The percent of fine material in the loose fill affects its compression properties from rainfall.

1.2.6 Maximum Equipment Height

Maximum Equipment Height: The highest point on the equipment (i.e.: roof ridge, top of support pole).

1.2.7 Play Event

Play Event: A piece of manufactured playground equipment that supports one

or more play activities.

1.3 CHILD SAFETY AND ACCESSIBILITY STANDARDS

The perimeters of the play event use zone shall be measured in accordance with the requirements of Section 02882: PLAYGROUND EQUIPMENT.

1.3.1 CHILD SAFETY

Loose-fill surfacing systems installed in the use zones shall meet or exceed the impact attenuating performance requirements as follows. The surfacing critical height value shall yield up to both a maximum 200 G's peak deceleration, and a maximum 1,000 Head Injury Criteria (HIC) value for a head-first fall from the play event in accordance with CPSC Pub No 325 and ASTM F 1292. The protective surfacing should have a minimum critical height value equal to the height of the highest designated play surface. Measuring fall heights for play events is defined in paragraph FALL HEIGHT.

Sand, gravel, and wood products shall not be installed over a concrete or bituminous subsurface per CPSC Pub No 325.

1.3.2 CHILD ACCESSIBILITY

The accessibility requirement in accordance with ASTM F 1487 includes the following: When the play event use zone consists of a protective surfacing rated as unaccessible, at least one accessible route shall be provided from the use zone perimeter to the play event. When there is more than one of the same play activity provided, only one shall meet accessibility requirements i.e.: one swing seat or one spring rocking play event). When the access and egress points are not the same for a play event, an accessible route shall be provided to both. The accessible route shall access all accessible play events and elements. The protective surfacings that meet accessibility are synthetic surfacing and engineered wood fiber per ASTM PS 83. When the accessible surface is within the use zone, it shall meet the requirements of paragraph CHILD SAFETY

1.4 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having a "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-01 Data

Loose Fill Surfacing; GA. Geotextile; GA.

Manufacturer's descriptive data; catalogue cuts; and the latest edition of ASTM F 1487 and CPSC Pub No 325.

Manufacturer's Qualifications; GA.

Name of the owner or user; service or preventive maintenance provider; date of the installation; point of contact and telephone number; and address for 10 sites.

Site Preparation; GA.

Playground equipment and site furnishings installed.

Temperature Limitation; GA.

Temperature limitation for applying adhesive.

Color; GA.

Two color charts displaying surfacing colors, color granule percentages and finishes.

SD-04 Drawings

Shop Drawings; GA.

Scale drawings defining the revised use zone configuration.

SD-09 Reports

Percolation Test; GA.

A certified report of inspection, test method used and compliance with recognized test standard shall be described.

SD-13 Certificates

Materials; GA.

Prior to the delivery of materials, certificates of compliance attesting that materials meet the specified requirements. Certified copies of the material certificates shall include composition and tests to which the material has been subjected.

Manufacturer's Qualification; GA.

Certificate of Insurance AA rated for a minimum one million dollars.

Manufacturer's Representative; GA.

The individual's name, company name and address, and playground safety training certificate.

Installer's Qualification; GA.

The installer's company name and address, and training and experience certification.

Substitution; GA.

Technical representative's written approval.

Child Safety and Accessibility Evaluation; GA.

Record of measurements and findings by the certified playground safety inspector. Verification that the installed protective surfacing meets manufacturer's recommendations and paragraph CHILD SAFETY AND ACCESSIBILITY STANDARDS.

SD-14 Samples

Loose Fill Surfacing; GA.

- a. Loose Fill Surfacing: A minimum 0.125 cu. ft sample.

SD-19 Operation and Maintenance Manuals

Maintenance Instruction; GA.

Two bound copies of manufacturer's operation and maintenance manuals. The Contractor shall include manufacturer supplied spare parts.

1.5 DELIVERY, STORAGE, AND HANDLING

A delivery schedule shall be provided at least 10 calendar days prior to the first day of delivery. Protective surfacing material shall be delivered, handled, and stored in accordance with the manufacturer's recommendations. The storage area shall be as designated. The materials shall be stored in a dry, covered area until installed.

1.6 INSPECTION

Protective surfacing material shall be inspected upon arrival at the job site for meeting specified quality. Unacceptable materials shall be removed from the job site.

1.7 MANUFACTURER'S QUALIFICATION

Protective surfacing should have been installed in a minimum 10 sites and been in successful service for a minimum 5 calendar year period. The manufacturer shall provide a Certificate of Insurance AA rated for a minimum one million dollars covering both product and general liability.

1.8 INSTALLER'S QUALIFICATION

The installer shall be certified by the manufacturer for training and experience installing the protective surfacing.

1.9 WARRANTY

Furnished protective surfacing shall have a minimum 1 calendar year period warranty.

1.10 TECHNICAL REPRESENTATIVE

1.10.1 Playground Areas

The technical representative for outdoor play areas shall be the Contracting Officer's Representative. The design of these outdoor play areas shall be based on the play program and the age groups to be accommodated as determined by the play area committee.

1.11 MANUFACTURER'S REPRESENTATIVE

The manufacturer's certified playground safety inspector or the manufacturer's designated certified playground safety representative shall supervise the installation and adjustment of the protective surfacing to verify the installation meets the requirements of the manufacturer, this specification, and paragraph CHILD SAFETY AND ACCESSIBILITY STANDARDS.

PART 2 PRODUCTS

2.1 MATERIALS

Materials shall be the standard products of a manufacturer regularly engaged in the manufacture of protective surfacing and shall be similar to surfacing in satisfactory use a minimum 5 calendar year period. Protective surfacing consists of two systems; synthetic surfacing and loose fill surfacing.

2.2 SYNTHETIC SURFACING

Synthetic surfacing includes the following: tile system. The synthetic surfacing consists of either impact attenuating substrate covered by a wear surface bonded to produce a unified system; a shredded rubber or aggregate substrate covered by a polyethylene plastic woven sheet wear surface; or a uniform material manufactured in such a way that the top portion meets the requirements specified for wear surface.

2.2.1 Subbase

The subbase for synthetic surfacing shall be pea gravel, as shown.

2.2.2 Wood Fiber Surfacing

The playground surface shall be "SoftStep" chipped wood surfacing material, as supplied by Earl F. Andersen, Inc., or equal, and is manufactured from wood of the genus Populus. The playground surfacing shall be suitable for playground surfacing and shall be tested to meet ASTM F 1292 standards for fall absorbency of a playground surface. The playground surfacing shall be tested to meet the accessibility criteria of ASTM PS 83 for wheelchair accessibility. Upon request, submit one sample showing the material to be supplied and a copy of the ASTM F 1292 and ASTM PS 83 test reports. Treated wood, standard wood chips, bark mulch, recycled wood from pallets and waste wood shall not be acceptable. The wood surfacing shall consist of the approximate sizes and in the following proportions in bulk:

<u>Particle Size</u>	<u>Percentage of Sample</u>
Particles passed through 5/8" sieve, but retained on 1/2" sieve	3%
Particles passed through 1/2" sieve, but retained on 3/8" sieve	10%
Particles passed through 3/8" sieve, but retained on 1/4" sieve	58%
Particles passed through 1/4" sieve, but retained on 1/8" sieve	22%
Particles passed through 1/8" sieve, but retained on pan	7%

2.2.3 Containment Curbs

Containment curbs include the following: concrete, recycled plastic, or recycled plastic molded as lumber. Containment curbs shall provide a smooth and hazard-free transition from the protective surfacing to the adjacent surface. Curbs shall be free of sharp vertical edges, protruding elements and trip hazards. Curbs shall be as recommended by the manufacturer. All edges should be provided with a minimum 1/2 inch radius.

2.2.3.1 Border Material

Border shall be TuffTimber edger by Landscape Structures, Inc. or equal and be rotationally molded from U.V. stabilized, 100% recycled/reclaimed linear low-density polyethylene. It shall be no less than 12" high and have molded in sleeves for stakes. Stakes shall be steel, 30" in length, and hot dip galvanized.

2.3 GEOTEXTILE FABRIC

Geotextile shall be provided as shown. Geotextile materials and installation shall be as specified in SECTION 02373: SEPARATION GEOTEXTILE.

2.4 RECYCLED PLASTIC

Recycled plastic shall contain a minimum 85 percent of recycled post-consumer product.

2.4.1 High Density Polyethylene

The material shall be molded of ultraviolet (UV) and color stabilized polyethylene; and consist of a minimum 75% plastic profile of high-density polyethylene, low-density polyethylene, and polypropylene raw material. The material shall be non-toxic and have no discernible contaminants such as paper, foil, or wood. The material shall contain a maximum 3 percent air voids. The material shall be free of splinters, chips, peels,

buckling, and cracks. Material shall be resistant to deformation from solar heat gain. Material shall have factory-drilled holes. Components with extra holes not filled by hardware or covered by other components shall be rejected. The material shall not be painted.

2.4.2 Structural Component

Recycled plastic materials will not be used as load bearing structural members.

2.5 CURBS

2.5.1 Concrete Curb

Concrete curbs shall conform to Section 02770 CONCRETE SIDEWALKS AND CURBS AND GUTTERS

PART 3 EXECUTION

3.1 SITE PREPARATION

Prior to installing the protective surfacing, verify the playground equipment and site furnishings are installed in accordance with Section 02882 PLAYGROUND EQUIPMENT, and Section 02870 SITE FURNISHINGS.

3.1.1 Finished Grade and Underground Utilities

The Contractor shall verify that finished grades are as indicated; the smooth grading has been completed in accordance with Section 02300 EARTHWORK; installation of the underground utilities through the area has been completed in accordance with Section 02316 EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS; installation of the storm-drainage system through the area has been completed in accordance with Section 02630 STORM-DRAINAGE SYSTEM. The location of underground utilities and facilities in the area of the operation shall be verified. Damage to underground utilities and facilities shall be repaired at the Contractor's expense.

3.1.2 Layout

The layout of the entire use zone perimeter shall be staked before excavation begins. The location of all elements shall be staked to include the following: All play event configuration access and egress points; and use zone perimeters.

3.1.2.1 Use Zone

The use zone is defined as the area beneath and immediately adjacent to a play structure or equipment that is designated for unrestricted circulation around equipment; and on whose surface it is predicted that a user would land when falling from or exiting the equipment. Also, the use zone is associated with the following terms; "Clear Area," and "Fall Zone". The use zone shall be free of hard surfaces, objects or obstacles that a child could run into or fall on top of and be injured. Use zone perimeters shall

not overlap hard surfaces. The use zone perimeter shall meet or exceed the requirements of paragraph CHILD SAFETY AND ACCESSIBILITY STANDARDS. Use zone perimeters shall not overlap except for certain play events as defined in ASTM F 1487.

3.1.2.2 Shop Drawings

When the use zone perimeter and play event configuration conflict with the requirements and Paragraph: CHILD SAFETY AND ACCESSIBILITY STANDARDS, shop drawings defining corrective measures shall be submitted to include the following: Adjustment to the play event with the use zone perimeter; use zone perimeter overlaps; fall height and critical height value.

3.1.3 Obstructions Below Ground

When obstructions below ground affect the work, shop drawings showing proposed adjustments shall be provided.

3.1.4 Percolation Test

A test for percolation shall be done to determine positive drainage, to include the lowest elevation of the subgrade in the areas containing the following: sand; gravel; wood by-products; or synthetic surfacing installed over a pervious base. A positive percolation shall consist of a minimum 1 inch per 3 hour period. When a negative percolation test occurs, a shop drawing shall be provided to indicate the corrective measures.

3.1.5 Substitution

Under no circumstances are substitutions to be allowed or protective surfacing to be selected without written approval from the Contracting Officer. Evaluate manufacturer substitutions for the critical height value with meeting the site conditions and paragraph FALL HEIGHT.

3.1.6 Subgrade

Subgrade irregularities shall be corrected to ensure the required depth of protective surfacing is provided. The subgrade elevation shall be as required by the manufacturer.

3.1.7 Subsurface

The subsurface shall be installed in a true, even plane, and sloped to provide positive drainage as indicated.

3.1.8 Subbase

Tolerance of aggregate subbase shall be within a maximum similar to 1/4 inch in 10 feet. Aggregate subbase shall be compacted to a maximum 95 percent, ASTM D 1557. The compaction shall be completed in accordance with Section 02300 EARTHWORK. Sand, gravel, and wood products shall not be installed over a concrete, aggregate, or bituminous subbase, per paragraph CHILD SAFETY.

3.1.9 Fall Height

3.1.9.1 General Requirements

The fall height is defined as the vertical distance between the finished elevation of the designated play surface and the finished elevation of the protective surfacing beneath it. For some play events the fall height and platform height are the same, while for other play events the fall height and maximum equipment height are the same, Section 02882 PLAYGROUND EQUIPMENT. When the furnished play event fall height varies from the play event shown, shop drawings shall be provided defining the revised depth or type of protective surfacing to meet or exceed the requirements of paragraph CHILD SAFETY AND ACCESSIBILITY STANDARDS.

3.1.9.2 Measuring Fall Height

EQUIPMENT	MEASURING FALL HEIGHT
Composite Equipment Structure:	For a platform surrounded by protective barriers, measure from the platform finished elevation.
	For a platform surrounded by guardrails, measure from the guardrail top elevation.
Infant Crawl Area:	A maximum 24 inch height, measured from the crawl wall or barrier finished elevation.
Playhouse, Nonclimbable:	Measure from the designated play surface finished elevation.
Spring Rocking Equipment:	Measure from the seat top elevation.
Stationary Equipment, Climbable:	Measure from the maximum equipment height finished elevation.
Stationary Equipment, Nonclimbable:	Measure from the designated play surface finished elevation.
Swing:	Measure from the bottom of the pivot point.

3.2 RESTORATION AND CLEAN UP

When the operation has been completed, the Contractor shall clean up and protect the site. Existing areas that have been damaged from the operation shall be restored to original condition at the Contractor's expense.

3.2.1 Clean Up

The site and play events shall be cleaned of all materials associated with the operation. Play events and surfaces shall be cleaned of dirt, stains, filings, and other blemishes occurring from shipment and installation. Cleaning methods and agents shall be as recommended by the manufacturer.

3.2.2 Protection

The area shall be protected as required or directed by providing barricades and signage. Signage shall be in accordance with Section 10430 EXTERIOR SIGNAGE

3.2.3 Disposal of Materials

Excess and waste material shall be removed and disposed of off Government property.

3.3 PROTECTIVE SURFACING ACCEPTANCE

3.3.1 Child Safety and Accessibility Evaluation

When the protective surfacing is installed, the play events and protective surfacing shall be thoroughly inspected and measured to verify the playground meets manufacturer's recommendations, paragraph CHILD SAFETY AND ACCESSIBILITY STANDARDS, and paragraph FALL HEIGHT as follows: 1) secure anchoring; 2) all hardware and connectors are tight and below the wear surface; 3) sharp points, edges, and protrusions; 4) entanglement; and 5) pinch, crush, and shear points. Measure use zone distances to determine the area is free of hard surfaces, objects or obstacles. Determine exceptions to use zone overlaps occur in accordance with ASTM F 1487. Measure play event fall height and depth of loose fill protective surfacing. Ensure the slide exit region has the required clear zone. Swing seat clearances are measured while occupied by a maximum user for the age group using the equipment. The finished installation shall have the appearance of a single covering. Protective surfacing that does not comply shall be reinstalled. Hardware that does not comply shall be replaced. Ensure positive drainage for the area and the lowest elevation of protective surfacing subgrade has been provided. A written report describing the results of the evaluation shall be provided.

3.3.2 Maintenance Instruction

The manufacturer's operation and maintenance manual describing the recommended preventive maintenance, inspection frequency and techniques, periodic adjustments, lubricants, and cleaning requirements shall be furnished.

3.4 RE-INSTALLATION

When re-installation is required, the following shall be accomplished. Re-install the product as specified. Provide new replacement materials supplied by the manufacturer (material acquisition of replacement parts is the responsibility of the Contractor). Damage caused by the failed

installation shall be repaired at the Contractor's expense.

-- End of Section --

SECTION TABLE OF CONTENTS

DIVISION 02 - SITE WORK

SECTION 02870

SITE FURNISHINGS

04/01

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 SUBMITTALS
- 1.3 DELIVERY, STORAGE, AND HANDLING
- 1.4 INSPECTION

PART 2 PRODUCTS

- 2.1 MATERIALS
 - 2.1.1 Concrete
 - 2.1.1.1 Cast-in-Place Concrete
 - 2.1.2 Masonry
 - 2.1.3 Metal
 - 2.1.3.1 Steel
 - 2.1.3.2 Reinforcing Steel
 - 2.1.3.3 Cast Iron
 - 2.1.3.4 Cast Aluminum
 - 2.1.3.5 Bronze, Copper and Other Ounce Metals
 - 2.1.4 Recycled Material
 - 2.1.4.1 General Requirements
 - 2.1.4.2 High Density Polyethylene
 - 2.1.4.3 Structural Component
 - 2.1.5 Fiberglass
- 2.2 HARDWARE
- 2.3 ANCHORS
- 2.4 FINISH
 - 2.4.1 Coatings
 - 2.4.1.1 Galvanizing
 - 2.4.1.2 Polyester Powder
 - 2.4.1.3 Polyvinyl-chloride (PVC)
 - 2.4.2 Paint
- 2.5 SITE FURNISHING STANDARDS
- 2.6 BENCHES
- 2.7 PICNIC TABLES
- 2.8 TRASH RECEPTACLES
- 2.9 BIKE RACKS
- 2.10 BOLLARDS
- 2.11 DRINKING FOUNTAINS
- 2.12 TELEPHONE ENCLOSURE
- 2.13 GRILLS

- 2.14 SIGNS
- 2.15 PICNIC SHELTERS
- 2.16 Kiosk Sign Cabinet

PART 3 EXECUTION

- 3.1 INSTALLATION
 - 3.1.1 Parts
 - 3.1.2 Assembly
 - 3.1.3 Testing
- 3.2 RESTORATION AND CLEAN UP
 - 3.2.1 Clean Up
 - 3.2.2 Protection
 - 3.2.3 Disposal of Materials
- 3.3 RE-INSTALLATION

-- End of Section Table of Contents --

SECTION 02870

SITE FURNISHINGS

04/01

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications shall be referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 36/A 36M	(1996) Carbon Structural Steel
ASTM A 48	(1994a) Gray Iron Castings
ASTM A 48M	(1994) Gray Iron Castings (Metric)
ASTM A 123	(1989a) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 153	(1996) Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 500	(1993) Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM A 501	(1993) Hot-Formed Welded and Seamless Carbon Steel Structural Tubing
ASTM A 615/A 615M	(1996a) Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
ASTM B 26/B 26M	(1996a) Aluminum-Alloy Sand Castings
ASTM B 62	(1993) Composition Bronze or Ounce Metal Castings
ASTM B 108	(1996a) Aluminum-Alloy Permanent Mold Castings
ASTM C 150	(1996) Portland Cement
ASTM D 648	(1996) Deflection Temperature of Plastics Under Flexural Load

ASTM D 2990	(1995) Tensile, Compressive, and Flexural Creep and Creep-Rupture of Plastics
ASTM F 1487	(1995) Standard Consumer Safety Performance Specification for Playground Equipment for Public Use

1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having a "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-01 Data

Site Furnishings; GA.

Manufacturer's descriptive data and catalog cuts.

SD-04 Drawings.

Site Furnishing Standards; GA.

Drawings showing scaled details of proposed site furnishings, elevations for each type of site furnishing; dimensions, details, and methods of mounting or anchoring; shape and thickness of materials; and details of construction.

SD-06 Instructions

INSTALLATION; GA.

Manufacturer's installation and maintenance instructions.

SD-08 Statements

Materials; GA.

A listing indicating the furnishings provided have been in proven satisfactory use for at least 2 years.

SD-09 Reports

Recycled Material; GA

A report of site furnishing parts consisting of recycled materials. Product specification data shall provide test information for deflection and creep in accordance with ASTM D 648 and ASTM D 2990 for site furnishings which use plastic lumber as a component, shall be submitted. The data shall provide a comparison of deflection and creep measurements to other comparable materials.

SD-14 Samples

FINISH; GA.

Two sets of color data for each furnishing displaying manufacturer's color selections and finishes, and identifying those colors and finishes proposed for use.

1.3 DELIVERY, STORAGE, AND HANDLING

Materials shall be delivered, handled, and stored in accordance with the manufacturer's recommendations. The storage area shall be as designated. The materials shall be stored in a dry, covered area until installed.

1.4 INSPECTION

Site furnishings shall be inspected upon arrival at the job site for conformity to specifications and quality in accordance with paragraph MATERIALS. Unacceptable items shall be removed from the job site.

PART 2 PRODUCTS

2.1 MATERIALS

Materials shall be the standard products of a manufacturer regularly engaged in the manufacture of such products. The materials provided shall be of a type with proven satisfactory use for at least 2 years. Benches, drinking fountains, grills, and telephone enclosures shall be ADA approved.

2.1.1 Concrete

Portland cement shall conform to ASTM C 150 Types I, II, or III.

2.1.1.1 Cast-in-Place Concrete

Cast-in-place concrete materials and products shall conform to Section 03300 CAST-IN-PLACE STRUCTURAL CONCRETE.

2.1.2 Masonry

Masonry material and products shall conform to Section 04200 MASONRY.

2.1.3 Metal

Metallic materials and products shall conform to Section 05055 METALWORK FABRICATION, MACHINE WORK, MISCELLANEOUS PROVISIONS. Metal components shall be furnished with factory drilled holes. Components shall be free of excess weld and spatter. Metal components with holes that will not be filled by hardware or hidden by other components will be rejected.

2.1.3.1 Steel

Structural steel products shall conform to ASTM A 36/A 36M, ASTM A 500 and ASTM A 501.

2.1.3.2 Reinforcing Steel

Steel used for reinforcement shall be deformed billet steel Grade 40. Steel shall conform to ASTM A 615/A 615M.

2.1.3.3 Cast Iron

Cast iron shall conform to ASTM A 48 Class 35 or better. The Contractor shall provide castings manufactured true to pattern and component parts that fit together in a satisfactory manner. Castings shall be of uniform quality, free from blowholes, porosity, hard spots, shrinkage, distortion, or other defects. Smooth castings shall be well-cleaned by sand or shot blasting.

2.1.3.4 Cast Aluminum

Cast aluminum shall conform to ASTM B 26/B 26M and ASTM B 108. The Contractor shall provide castings manufactured true to pattern and component parts that fit together in a satisfactory manner. Castings shall be of uniform quality, free from blowholes, porosity, hard spots, shrinkage, distortion, or other defects. Smooth castings shall be well-cleaned by sand or shot blasting.

2.1.3.5 Bronze, Copper and Other Ounce Metals

Bronze, copper, and other ounce metals shall conform to ASTM B 62.

2.1.4 Recycled Material

2.1.4.1 General Requirements

Recycled materials shall contain a minimum 85 percent recycled post-consumer product. Recycled materials shall be constructed or manufactured with a maximum 1/4-inch deflection or creep in any member in conformance with ASTM D 648 and ASTM D 2990.

2.1.4.2 High Density Polyethylene

The Contractor shall provide panels and components molded of ultraviolet (UV) and color stabilized polyethylene, with minimum 1/4 inch wall thickness; exposed edges shall be smoothed, rounded, and free of burrs and points; and the material shall be resistant to fading, cracking, fogging, and shattering. The material shall be non-toxic and have no discernible contaminants such as paper, foil, or wood. The material shall contain no more than 3 percent air voids. Material shall be resistant to deformation from solar radiation heat gain.

2.1.4.3 Structural Component

Recycled materials to include plastic lumber will not be used as structural components of site furnishings.

2.1.5 Fiberglass

Fiberglass shall consist of at least 3 laminations of chopped glass fibers impregnated with polyester resin, with colors and textures molded into all exposed surfaces so that colors resist fading. Fiberglass shall be resistant to cleaners, fertilizers, high power spray and salt.

2.2 HARDWARE

Hardware shall be stainless steel or galvanized steel as indicated, in accordance with ASTM A 153 and compatible with the material to which applied. All exposed hardware shall match in color and finish. Mounting hardware shall be concealed, recessed, and plugged.

2.3 ANCHORS

Anchors shall be provided, where necessary, for fastening site furnishings securely in place and in accordance with approved manufacturer's instructions. Anchoring devices that may be used, when no anchors are otherwise specified or indicated, include anchor bolts, slotted inserts, expansion shields for concrete; toggle bolts and through bolts for masonry; machine carriage bolts for steel; and lag bolts and screws for wood.

2.4 FINISH

Finish shall be as specified by the manufacturer or as indicated. Exposed surfaces and edges shall be rounded, polished, or sanded. Finish shall be non-toxic, non-glare, and resistant to corrosion. Exposed surfaces shall be smooth and splinter-free exposed surfaces.

2.4.1 Coatings

2.4.1.1 Galvanizing

Galvanized components shall be hot-dipped in zinc after fabrication in accordance with ASTM A 123. Tailings and sharp protrusions formed as a result of the hot-dip process shall be removed and exposed edges burnished.

2.4.1.2 Polyester Powder

Powder-coated surfaces shall receive electrostatic zinc coating prior to painting. Powder coating shall be electrostatically applied and oven cured. Polyester powder coating shall be resistant to ultraviolet (UV) light.

2.4.1.3 Polyvinyl-chloride (PVC)

PVC coating shall be primed with a clear acrylic thermosetting solution. The primed parts shall be preheated prior to dipping. The liquid polyvinyl chloride shall be ultraviolet (UV) stabilized and mold-resistant. The coated parts shall be cured. The coating shall be a minimum 2/25 inches thick plus or minus 0.020 inches and shall have an 85 durometer hardness with a slip-resistant finish.

2.4.2 Paint

Paint shall be factory applied with a minimum of 2 coats. Paint shall be weather-resistant and resistant to cracking, peeling and fading.

2.5 SITE FURNISHING STANDARDS

Site furnishings shall be furnished with the dimensions and requirements indicated.

2.6 BENCHES

a. BuMor Recycled Plastic Bench: Model 16-PL, 6 feet, or approved equal. Surface mount, recycled plastic slats in 'Cedar', 'Green' polyester power-coat finish.

b. Contact: Nancy Teel, Earl F. Andersen Company, Phone: 952-884-7300, Fax: 952-884-5619.

2.7 PICNIC TABLES

a. Eaglebrook Products ADA Portable Picnic Table: Model 9853, or approved equal. Galvanized metal finish, 'Cedar' recycled plastic slats.

b. DuMor Square Pedestal Table: Model 7633-33, or approved equal. 'Cedar' recycled plastic slats, 3-bench option for ADA accessibility, surface mount, 'Green' polyester powder-coat finish.

c. DuMor Square Pedestal Table: Model 7634-34, or approved equal. 'Cedar' recycled plastic slats, 4-bench option, surface mount, 'Green' polyester powder-coat finish.

d. Contact: Nancy Teel, Earl F. Andersen Company, Phone: 952-884-7300, Fax: 952-884-5619.

2.8 TRASH RECEPTACLES

a. DuMor Trash Receptacle: Model 124-31PL, or approved equal. 'Cedar' recycled plastic slats, surface mount, 'Green' polyester powder-coat finish.

b. Contact: Nancy Teel, Earl F. Andersen Company, Phone: 952-884-7300, Fax: 952-884-5619.

2.9 BIKE RACKS

a. Timberform: Cyclops Bike Rack: Model 2170-13-E-G, or approved equal. Thirteen bike capacity, surface mount, galvanized metal finish. Contact: John Masciopinto, Park and Plaza Products, Inc., Phone: 651-653-0556, Fax: 651-653-0598.

2.10 BOLLARDS

a. Timberform Recycled Plastic Bollard: Model 2553-3-E-M, or approved equal. Color shall be 'Cedar', no directional arrow.

b. Timberform Recycled Plastic Removable Bollard: Model 2553-3-R, or approved equal. Color shall be 'Cedar'.

c. Contact: John Masciopinto, Park and Plaza Products, Inc., Phone: 651-653-0556, Fax: 651-653-0598.

2.11 DRINKING FOUNTAINS

a. Most Dependable Fountains" Model Jug Filler DB, or approved equal. Direct embed mount, green polyester powder-coat finish. Contact: Most Dependable Fountains, Phone: 901-867-0039, Fax: 901-867-4008.

2.12 TELEPHONE ENCLOSURE

a. PBG Traditional Enclosure, or approved equal. Color shall be black; surface-mounted pedestal enclosure. Contact: Jessica Raynor, PBG, Phone: 800-264-8888, Fax: 770-887-9511.

2.13 GRILLS

a. Kay Grill: Model SF16, or approved equal. Surface mount, include optional utility shelf. Contact: Kay Products, Phone: 800-622-5425.

b. DuMor Dual Level Grill: Model #24, or approved equal. Surface mount. Contact: Nancy Teel, Earl F. Andersen Company, Phone: 952-884-7300, Fax: 952-884-5619.

2.14 SIGNS

a. Best Signs Custom Regulatory Signage, or approved equal. Contact: Paula, Construction Supply, Inc. , Phone: 763-537-5018.

2.15 PICNIC SHELTERS

Both shelters listed below shall have custom masonry work on the columns and shall have pre-cut steel roof in "hunter green".

a. Large Shelter: Litchfield Industries: 'Telluride' Shelter, Model: 7253, vented roof or approved equal.

b. Small Shelter: Litchfield Industries: ;Steel Beam; Shelter (20' x 36'), Model: 2217, or approved equal.

c. Contact: Litchfield Industries, Inc., Phone: 800-542-5282, Fax: 517-542-3939.

2.16 Kiosk Sign Cabinet

Hopewell Manufacturing: Bulletin case, or approved equal. 36 inches wide x 48 inches high frame sandblasted with clear finish. Custom mount vertical. Contact: Paul Kramer, Hopewell Manufacturing. Phone: 301-582-2343, fax: 301-582-2343.

PART 3 EXECUTION

3.1 INSTALLATION

The Contractor shall verify that finished grades and other operations affecting mounting surfaces have been completed prior to the installation of site furnishings. Site furnishings shall be installed plumb and true in accordance with the approved manufacturer's instructions.

3.1.1 Parts

New parts shall be acquired from the manufacturer. Substitute parts will not be accepted unless approved by the manufacturer.

3.1.2 Assembly

When the inspection of parts has been completed, the site furnishings shall be assembled and anchored according to manufacturer's instructions or as indicated. When site furnishings are assembled at the site, assembly shall not interfere with other operations or pedestrian and vehicular circulation.

3.1.3 Testing

Each site furnishing shall be tested to determine a secure and correct installation. A correct installation shall be according to the manufacturer's recommendations and by the following procedure: The Contractor shall measure the physical dimensions and clearance of each installed site furnishing for compliance with manufacturer's recommendations and as indicated. Site furnishings which do not comply shall be reinstalled. Fasteners and anchors determined to be non-compliant shall be replaced. A written report describing the results of the testing shall be provided.

3.2 RESTORATION AND CLEAN UP

When the installation has been completed, the Contractor shall clean up and protect the site. Existing areas that have been damaged from the installation operation shall be restored to original condition at Contractor's expense.

3.2.1 Clean Up

The site shall be cleaned of all materials associated with the installation. Site furnishing surfaces shall be cleaned of dirt, stains, filings, and other blemishes occurring from shipment and installation. Cleaning methods and agents shall be according to manufacturer's instructions or as indicated.

3.2.2 Protection

The area shall be protected as required or directed by providing barricades and signage. Signage shall be in accordance with Section 10430 EXTERIOR SIGNAGE.

3.2.3 Disposal of Materials

Excess and waste material shall be removed and disposed off Government property.

3.3 RE-INSTALLATION

Where re-installation is required, the following shall be accomplished:

- a. Re-install the product as specified. Material acquisition of replacement parts is the responsibility of the Contractor. Provide replacement materials that are new and supplied by the original manufacturer to match.
- b. Damage caused by the failed installation shall be repaired.

-- End of Section --

SECTION TABLE OF CONTENTS

DIVISION 02 - SITE WORK

SECTION 02882

PLAYGROUND EQUIPMENT

04/01

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 DEFINITIONS
 - 1.2.1 Age Appropriate
 - 1.2.2 Composite Structure
 - 1.2.3 Designated Play Surface
 - 1.2.4 Maximum Equipment Height
 - 1.2.5 Play Event
 - 1.2.6 Protective Surfacing
 - 1.2.7 Suspended Hazard
 - 1.2.8 Tot
- 1.3 CHILD SAFETY AND ACCESSIBILITY STANDARDS
 - 1.3.1 Child Safety
 - 1.3.2 Child Accessibility
- 1.4 SUBMITTALS
- 1.5 DELIVERY, STORAGE, AND HANDLING
- 1.6 EQUIPMENT IDENTIFICATION
- 1.7 INSPECTION
- 1.8 PROHIBITED EQUIPMENT
- 1.9 AGE GROUPS
 - 1.9.1 Playground Areas
- 1.10 MANUFACTURER QUALIFICATION
- 1.11 INSTALLER QUALIFICATION
- 1.12 WARRANTY
- 1.13 TECHNICAL REPRESENTATIVE
 - 1.13.1 Playground Areas
- 1.14 MANUFACTURER'S REPRESENTATIVE

PART 2 PRODUCTS

- 2.1 PLAY EQUIPMENT GENERAL SPECIFICATIONS
 - 2.1.1 Material
 - 2.1.2 Bolt links/double clevis
 - 2.1.3 P.V.C. Coatings
 - 2.1.4 Polyester Powder Coating
 - 2.1.5 Rotationally Molder Poly Parts
 - 2.1.6 Permalene
- 2.2 PLAYSTRUCTURE
 - 2.2.1 Aluminum Posts
 - 2.2.2 Decks

- 2.2.3 Transfer Module
- 2.2.4 Pipe Barrier
- 2.2.5 Activity Panels
- 2.2.6 Driver Panel
- 2.2.7 Vertical Ladders
- 2.2.8 Double Swoosh Slide
- 2.2.9 Slidewinder
- 2.2.10 Firepoles
- 2.2.11 Loop Pole
- 2.2.12 Wiggle Ladder
- 2.2.13 Loop Horizontal Ladder
- 2.2.14 2" Horizontal Ladder Support
- 2.2.15 Clatterbridge
- 2.2.16 Belt Bridge
- 2.2.17 Chinning Bar
- 2.2.18 Snake Climber
- 2.2.19 Handhold/Leg Lift
- 2.2.20 Loop Seats
- 2.2.21 Belt Wing Unit
- 2.2.22 Full Bucket Seat
- 2.2.23 Molded Bucket Seat
- 2.3 MAINTENANCE PROGRAM SPECIFICATION FOR PLAYGROUND EQUIPMENT
- 2.4 PLAY EQUIPMENT
 - 2.4.1 Playground Layout A
 - 2.4.2 Playground Layout B
 - 2.4.3 Playground Layout C
 - 2.4.4 Manufacturer Contact

PART 3 EXECUTION

- 3.1 SITE PREPARATION
 - 3.1.1 Finished Grade and Underground Utilities
 - 3.1.2 Layout
 - 3.1.2.1 Use Zone
 - 3.1.2.2 Shop Drawings
 - 3.1.3 Orientation
 - 3.1.4 Obstructions Below Ground
- 3.2 INSTALLATION
 - 3.2.1 Play Event Modification
 - 3.2.2 Wood Finish
 - 3.2.3 Plastic Play Events
 - 3.2.4 Footings
 - 3.2.5 Multiple-Axis (Rotating) Swing
 - 3.2.6 Single-Axis (To-Fro) Swing
 - 3.2.7 Slide
 - 3.2.8 Chain or Rope Ladder, Climber or Net Climber
 - 3.2.9 Composite Structure
 - 3.2.10 Fall Height
 - 3.2.10.1 General
 - 3.2.10.2 Measuring Fall Height
- 3.3 RESTORATION AND CLEAN UP
 - 3.3.1 Clean Up
 - 3.3.2 Disposal of Materials
- 3.4 PLAYGROUND ACCEPTANCE

- 3.4.1 Child Safety and Accessibility Evaluation
- 3.4.2 Spare Parts
- 3.4.3 Maintenance Instructions
- 3.5 RE-INSTALLATION

-- End of Section Table of Contents --

SECTION 02882

PLAYGROUND EQUIPMENT

04/01

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 123	(1997a) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 135	(1997) Electric-Resistance-Welded Steel Pipe
ASTM A 153	(1995) Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 500	(1996) Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM A 513	(1997) Electric-Resistance-Welded Carbon and Alloy Steel Mechanical Tubing
ASTM B 26	(1997) Aluminum Alloy Sand Castings
ASTM B 108	(1997) Aluminum-Alloy Permanent Mold Castings
ASTM B 117	(1997) Operating Salt Spray (Fog) Apparatus
ASTM B 179	(1995a) Aluminum Alloys in Ingot Form for Castings from All Casting Processes
ASTM B 221	(1996) Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
ASTM D 368	(1995) Test Method for Specific Gravity of Creosote and Oil-Type Preservatives
ASTM D 648	(1997) Deflection Temperature of Plastics Under Flexural Load

ASTM D 822	(1996) Conducting Tests on Paint and Related Coatings and Materials Using Filtered Open-Flame Carbon Arc Exposure Apparatus
ASTM D 1248	(1984; R 1989) Polyethylene Plastics Molding and Extrusion Materials
ASTM D 1735	(1992) Testing Water Resistance of Coatings Using Water Fog Apparatus
ASTM D 2454	(1995) Determining the Effect of Overbaking on Organic Coatings
ASTM D 2794	(1993) Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact)
ASTM D 3359	(1995a) Measuring Adhesion by Tape Test
ASTM D 3363	(1992a) Film Hardness by Pencil Test
ASTM D 6112	(1997) Compressive and Flexural Creep and Creep-Rupture of Plastic Lumber and Shapes
ASTM F 1487	(1997c) Standard Consumer Safety Performance Specification for Playground Equipment for Public Use

CONSUMER PRODUCT SAFETY COMMISSION (CPSC)

CPSC Pub No 325	(1994) Handbook for Public Playground Safety
-----------------	--

1.2 DEFINITIONS

1.2.1 Age Appropriate

Age-Appropriate: A term that describes equipment scale to include platform height, fall height and maximum equipment height, that allows safe and successful use by children of a specific chronological age; mental and physical ability; and anthropometric measurement. Maximum equipment height and complexity will not exceed a child's ability in that age group.

1.2.2 Composite Structure

Composite Structure: Also "Composite Play Structure; Linked Structure". Two or more play events attached, directly adjacent or functionally linked, to create one integral unit that provides more than one play activity.

1.2.3 Designated Play Surface

Designated Play Surface: Any elevated surface for standing, walking, sitting, or climbing; or a flat surface a minimum 2 inches wide having up

to a maximum 30 degree angle from horizontal. In some play events the platform surface will be the same as the designated play surface. However, the terms should not be interchanged as they do not define the same point of measurement per ASTM F 1487.

1.2.4 Maximum Equipment Height

Maximum Equipment Height: The highest point on the equipment (i.e., roof ridge, top of support pole).

1.2.5 Play Event

Play Event: A piece of manufactured playground equipment that supports one or more play activities.

1.2.6 Protective Surfacing

Protective Surfacing: Material to be used within the use zone that meets the fall attenuation requirements of Section 02791 PLAYGROUND PROTECTIVE SURFACING.

1.2.7 Suspended Hazard

Suspended Hazard: Cable, wire, rope or similar devices suspended up to a maximum 7 feet high between play events; or installed up to a maximum 45 degree angle from the ground to the play event.

1.2.8 Tot

Tot: A child under 4 years of age in the pre-toddler and toddler age group.

1.3 CHILD SAFETY AND ACCESSIBILITY STANDARDS

1.3.1 Child Safety

Play events shall meet the child safety performance requirements described in CPSC Pub No 325 and ASTM F 1487. The requirements include the following: Head and neck entrapment; sharp points, edges, and protrusions; entanglement; pinch, crush, and shear points; suspended hazards; play event access and egress points; play event use zone perimeter; and design criteria. Since ASTM F 1487 criteria is defined for the minimum user through the maximum user (2 through 12 years of age), the requirements for the infant or pre-toddler age group are not prescribed. This specification and Section 02791 PLAYGROUND PROTECTIVE SURFACING establish the requirements for the infant and pre-toddler age groups.

1.3.2 Child Accessibility

The accessibility requirement in accordance with ASTM F 1487 includes the following: When the play event use zone consists of a protective surfacing rated as unaccessible, at least one accessible route shall be provided from the use zone perimeter to the play event. When there is more than one of the same play activity provided, only one shall meet accessibility requirements (i.e., one swing seat or one spring rocking play event). When

the access and egress points are not the same for a play event, an accessible route shall be provided to both. The accessible route shall access all accessible play events and elements. The protective surfacing performance requirements shall be in accordance with Section 02791 PLAYGROUND PROTECTIVE SURFACING.

1.4 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having a "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-01 Data

Equipment; GA.

Manufacturer's descriptive data; catalog cuts; references; and the latest edition of ASTM F 1487 and CPSC Pub No 325. Manufacturer's specifications, handling and storage requirements, installation procedures, and safety data sheets to include the following: bare or painted metal platform and slide bed orientation from the direct sun; warnings; and child safety performance standards.

Equipment Identification; GA

A list to include part numbers of furnished play event and equipment materials and components.

Delivery, Storage and Handling; GA

Delivery schedule and manufacturer's name.

Manufacturer Qualifications; GA

Name of the owner or user; service or preventive maintenance provider; date of the installation; point of contact and telephone number; and address for 10 sites.

SD-04 Drawings

Configuration; GA

Scale drawings defining the revised play event configuration.

Shop Drawings; GA

Scale drawings defining the revised use zone perimeters and play event layout.

Fall Height; GA

Scale drawings defining the revised depth or type of protective surfacing.

Finished Grade and Underground Utilities; GA

Finished grade, underground utilities, storm-drainage system and irrigation system status; and location of underground utilities and facilities.

SD-13 Certificates

Materials; GA

Prior to the delivery of materials, certificates of compliance attesting that materials meet the specified requirements. Certified copies of the material certificates shall include composition and tests to which the material has been subjected.

Manufacturer Qualification; GA

Certificate of Insurance AA rated for a minimum one million dollars.

Manufacturer's Representative; GA

The individual's name, company name and address, and playground safety training certificate.

Substitution; GA

Technical representative's written approval.

Play Event Modifications; GA

Manufacturer's written approval.

Child Safety and Accessibility Evaluation; GA

Record of measurements and findings by the certified playground safety inspector. Verification the installed play events and equipment meet manufacturer's recommendations and paragraph CHILD SAFETY AND ACCESSIBILITY STANDARDS.

SD-14 Samples

Color; GA

Two color charts displaying the colors and finishes.

SD-19 Operation and Maintenance Manuals

Maintenance Instruction; GA.

Two bound copies of the manufacturer's operation and maintenance manuals.

Spare Parts; GA

Furnish manufacturer supplied spare parts.

1.5 DELIVERY, STORAGE, AND HANDLING

A delivery schedule shall be provided at least 10 calendar days prior to the first day of delivery. Equipment shall be delivered, handled, and stored in accordance with the manufacturer's recommendations. The storage area shall be as designated. The materials shall be stored in a dry, covered area until installed.

1.6 EQUIPMENT IDENTIFICATION

Playground equipment shall be identified with attached and durable label stating the age-group that the equipment is designed to accommodate. There shall be permanent WARNING labels and manufacturer's identification labels, ASTM F 1487.

1.7 INSPECTION

Playground equipment shall be inspected upon arrival at the job site for meeting age-appropriate requirements for the age-group that the equipment is designated to accommodate and specified quality in accordance with paragraphs MATERIALS and CONFIGURATION. Prohibited or unacceptable equipment shall be removed from the job site.

1.8 PROHIBITED EQUIPMENT

Equipment that does not meet the Army's developmental play program requirements and are prohibited on outdoor play areas include the following: chain balance beams; rotating equipment, such as merry-go-rounds, log rolls, whirls and may poles; fulcrum seesaws (teeter totters); spring rocking equipment intended for standing; animal figure swings; rope swings; multiple occupancy swings; swinging exercise and trapeze bars; swinging platforms; tire climbers; swinging dual exercise rings; roller slides; trampolines; swinging gates or doors; and new or used vehicle tires. Play houses or enclosures made of horizontal posts or bars with space between them. Wood components treated with creosote, pentachlorophenol, and tributyl tin oxide. Wood components coated with a finish containing pesticide.

1.9 AGE GROUPS

Play areas are designed to provide challenging play activities by age group. Playground equipment shall be designed to be age appropriate for the age group designated to use it. There is no anthropometric or fall attenuation significance to the discrepancy for the school-age age group between paragraph PLAYGROUND AREAS OTHER THAN CHILD DEVELOPMENT CENTERS and paragraph CHILD DEVELOPMENT CENTERS as described below. The Army age groups are defined as follows:

1.9.1 Playground Areas

The age groups accommodated at these areas range from less than 12 months through 12 years of age defined as the following: infant age group (less than 12 months); pre-toddler age group (12 through 24 months); composite toddler/pre-school age group (2 through 5 years of age); school-age age

group (5 through 9 years of age); and pre-teen age group (9 through 12 years of age). A multi-age playground consists of the following age groups: infant, pre-toddler, and composite toddler/pre-school age groups.

1.10 MANUFACTURER QUALIFICATION

Play events and equipment similar to those furnished shall have been installed in a minimum 10 sites and been in successful service for a minimum 5 year calendar period. The manufacturer shall provide a Certificate of Insurance AA rated for a minimum one million dollars covering both product and general liability.

1.11 INSTALLER QUALIFICATION

The installer shall be certified by the manufacturer for training and experience installing the play events and equipment.

1.12 WARRANTY

Furnished play events and equipment shall have a minimum 1 calendar year calendar period warranty.

1.13 TECHNICAL REPRESENTATIVE

1.13.1 Playground Areas

The technical representative for outdoor play areas shall be the Contracting Officer or Contracting Officer's Representative. The design of these outdoor play areas shall be based on the play program and the age groups to be accommodated as determined by the play area committee.

1.14 MANUFACTURER'S REPRESENTATIVE

The manufacturer's certified playground safety inspector or the manufacturer's designated certified playground safety representative shall supervise the installation and adjustment of the play events and equipment to verify the installation meets the requirements of the manufacturer, this specification, and paragraph CHILD SAFETY AND ACCESSIBILITY STANDARDS.

PART 2 PRODUCTS

2.1 PLAY EQUIPMENT GENERAL SPECIFICATIONS

2.1.1 Material

All materials shall be structurally sound and suitable for safe play. Durability shall be insured on all steel parts by the use of time tested coatings such as zinc plating, powder coating, P.V.C. coating, zinc-nickel plating, etc.

2.1.2 Bolt links/double clevis

Bolt links shall be steel forging with a zinc-nickel finish and equipped with a pinned-hex limited thread bolt. The double clevis shall be steel

casting. Fasteners are a hex head limited thread bolt and a hex-pin limited thread bolt.

2.1.3 P.V.C. Coatings

All metal components to be P.V.C. coated (or Tender Tuff-coated) shall be thoroughly cleaned, primed with a clear acrylic thermo setting solution, then shall be preheated prior to dipping in U.V. stabilized, liquid poly vinyl chloride, and either oven cured or salt cured. The finished coating shall be approximately .080" thick + .020", and have a matte finish.

2.1.4 Polyester Powder Coating

All metal components to be powder coated shall be free of excess weld and spatter. Parts shall then be thoroughly cleaned in a 6 stage pre-treatment system then thoroughly dried. Powder coating shall be electrostatically applied and oven cured. Average thickness shall be 4 Mils.

2.1.5 Rotationally Molder Poly Parts

These parts shall be molded of a linear low density polyethylene that is U.V. and color stabilized. Rotationally molded products shall meet or exceed tensile strength of 2700 psi per ASTM D 368.

2.1.6 Permalene

These parts shall be compression molded, ¾" thick, high density polyethylene that has been specially formulated for optimum U.V. stability and color retention.

2.2 PLAYSTRUCURE

2.2.1 Aluminum Posts

Posts shall be constructed of extruded seamless aluminum tubing. Posts shall have a 5" outside diameter. Post shall be a minimum of 42" above the deck height for proper height of walls to meet CPSC guideline. All posts shall be powder coated as specified. All posts shall have a "finish grade marker" positioned on the post identifying the bury line for correct installation. Top caps for posts shall be aluminum die-casting for durability rather than plastic, which can be broken. All caps shall be factory installed and secured in place. A molded low-density polyethylene cap shall be pressed onto the bottom ends of the post to increase the footing area. All clamps shall be die cast with a 369.1 alloy.

2.2.2 Decks

All TenderDecks or equal, shall be of modular design and have holes on the standing surface. Decks shall be manufactured from a single piece of low carbon 12-gauge sheet steel. The sheet shall be perforated then flanged formed and reinforced as necessary to insure structural integrity. The unit shall then be P.V.C.-coated for a slip resistant surface. Decks shall be designed so that all sides are flush with the outside edge of the supporting posts for a larger deck surface.

2.2.3 Transfer Module

The 16" high transfer deck shall have rounded edges, 7/8" perforations. Steps shall be fully enclosed and have perforated treads. Handrails shall be fabricated of steel tubing with a .120" wall thickness. All parts shall be TenderTuff-coated.

2.2.4 Pipe Barrier

This full barrier shall have a top horizontal rail constructed of steel tubing. Vertical rungs shall be solid steel bars for strength, welded to the rails to meet CPSC guidelines for a barrier wall. The bottom member shall be angle steel, which face mounts to the deck. After fabrication, entire unit shall be TenderTuff-coated for a non-slip, kid friendly surface.

2.2.5 Activity Panels

All panels shall be manufactured from Permalene or equal.

2.2.6 Driver Panel

The Driver Panel shall include a panel and PVC-coated steering wheel.

2.2.7 Vertical Ladders

This ladder from ground to decks shall consist of two Permalene handhold panels and a ladder fabricated from an outer rail formed from steel tubing while the rungs are welded at 12" center to center. The ladder and Permalene handhold panels shall attach to the face of the deck with standard fasteners. The ladder shall be TenderTuff-coated for a non-skid, durable, and kid friendly surface.

2.2.8 Double Swoosh Slide

Bedway shall be on piece and rotationally molded for durability. This double slide provides a 49 degree slope at the top for an exhilarating ride. 12" sidewalls at the top and a longer exit area ensure safety. A slide hood shall be provided.

2.2.9 Slidewinder

Slidewinder shall be rotationally molded and e comprised of one entrance section, one exit section and a combination of left or right elbow and straight sections. Sections shall be attached to each other with standard recessed fasteners. Slidewinder shall attach to 32" through 72" deck heights. There shall be an exit footer made from galvanized steel tubing and a mid-support shall be powder coated to match the slide color.

2.2.10 Firepoles

Poles shall be constructed of galvanized steel tubing. The firepole is attached to a top pipe. The unit shall have Permalene handhold panels. Unit shall be powder coated as specified.

2.2.11 Loop Pole

This event shall be constructed from a galvanized steel tube. The pole shall be bent to 180°. 180° climbing loops of galvanized steel tubing shall be continuously welded to pole. The pole shall also have (2) handgrips of galvanized steel tubing. Unit shall be powder coated as specified.

2.2.12 Wiggle Ladder

This climber shall consist of 4/0 zinc plated chain, with solid bar stock steel rails, which shall be TenderTuff-coated for a kid friendly surface. There shall be two Permalene handhold panels and be attached to the face of the deck, and the posts.

2.2.13 Loop Horizontal Ladder

(Single Beam) The ladder shall be fabricated from a galvanized steel beam with cast 535 aluminum magnesium end attachment brackets on welded crossover supports. 1.315" O.D. galvanized steel loops are formed at 180° and are continuously welded to the beam. The unit is powder coated.

2.2.14 2" Horizontal Ladder Support

Unit shall be constructed similar to the horizontal ladder utilizing 3 rungs. Units shall attach to the aluminum magnesium attachment brackets. Unit shall be powder coated as specified.

2.2.15 Clatterbridge

84" or 123" length as indicated, the clatterbridge mounting plates shall bolt to the face of the deck. The brown TenderTuff-coated clatterbridge planks shall have a stainless steel insert. Mounting plates and clatterbridge planks shall connect with connecting plates, oilite bushings and standard fasteners. Rails with welded steel clamps at both ends shall be a one piece unit with the tip beam a galvanized steel tube supporting a galvanized tube frame below. Trails shall be powder coated to a specified color.

2.2.16 Belt Bridge

The flush fitting belt shall be secured by a post-mounted frame and an adjustable cross bar at each end. This component shall utilize the same handrails and finish as the clatterbridge.

2.2.17 Chinning Bar

The chinning bar shall consist of a TenderTuff-coated rail assembly and a post.

2.2.18 Snake Climber

Main supports shall be formed from galvanized steel tubing capped at both

ends. Loops shall be formed at an 8" radius to 160° which makes and 18" center to center on the supports. The loops shall be formed from galvanized tubing welded to the main supports at an equal spacing. Galvanized steel legs shall incorporate a welded sleeve to secure the base of the climber. Snake climber shall have two Permalene handhold panels and be attached to the face of the deck. Climber is powder coated as specified.

2.2.19 Handhold/Leg Lift

This loop mounted horizontally to post adds a fitness activity. The unit shall be TenderTuff-coated.

2.2.20 Loop Seats

Loop seats shall be a part of the teen cluster and shall be fabricated from formed RS-20 galvanized steel tubing with (2) clamps continuously welded to each end. Unit is TenderTuff-coated.

2.2.21 Belt Wing Unit

This heavy duty swing unit shall be #100051 by Landscape Structures Inc., or equal, and be 8' or 10' height and with the number of seats as indicated in the drawings or specs, and shall consist of a 2" O.D schedule 40 steel top beam that is powder coated. The legs shall be 2" O.D. galvanized steel, with 3 legs at the ends of the unit. Yoke clamps shall be sand cast aluminum alloy and powder coated. Hardware shall be tamper proof in design. A "U" shaped bolt link shall be used for chain connections instead of "S" hooks. Belt seats shall be a blunt face slash proof type, 2 per bay. Chains shall be 4/0 straight link galvanized and if indicated in the specifications or drawings shall be TenderTuff-coated. Full bucket seats shall be molded of black rubber with a stainless steel reinforcing plate. A handle cast from aluminum with black neoprene grip place over the handle shall attach to the seat with stainless steel rivets.

2.2.22 Full Bucket Seat

Full bucket swing seats or tot seats, shall be molded of black rubber with a stainless steel reinforcing plate. A handle cast from aluminum with black neoprene grip placed over the handle shall attach to the seat with stainless steel rivets.

2.2.23 Molded Bucket Seat

This contour bucket swing seat shall be #100054 by Landscape Structures Inc., or equal, and is molded from durable polyethylene and have a supportive high back for the physically disadvantaged. The seat shall hang from 2 beam swing hangers and the chain shall make contact and hang from 4 spots on the seat.

2.3 MAINTENANCE PROGRAM SPECIFICATION FOR PLAYGROUND EQUIPMENT

As recommended by the Consumer Product Safety Commission (CPSC), a project specific Maintenance Manual shall be included with the play structure. The manual shall provide information to establish the frequency of inspections,

a description of preventative maintenance and repair procedures and play specific inspection report forms for each component part shown on the plan. It shall also include copies of the original plan, installation instructions and parts list.

Sandpaper, primer and touch-up paints shall be supplied. Primer and paints shall be in colors that match the structure and shall be compatible with the structure's powder coating. The manufacturer shall provide a chemical cleaner of adequate strength to remove paint, ink and other common forms of graffiti from most materials/surfaces on the structure. The manufacturer shall provide wrenches or other tools needed to adjust or replace vandal resistant fasteners.

2.4 PLAY EQUIPMENT

Play equipment listed below shall be furnished and installed. The equipment model numbers listed are for equipment from Landscape Structures, Inc. Equipment provided shall be those models listed from Landscape Structures, Inc. or approved equal. Colors will be selected by the Contracting Officer from manufacturer's standard colors.

2.4.1 Playground Layout A

Playground Layout A shall be constructed at the River Heights Trailhead and shall consist of the following:

Quantity	Model	Description
3	111404B	140" Post Alum For 64" Deck
1	111404C	132" Post Alum For 56" Deck
1	111404D	124" Post Alum For 48" Deck
8	111404E	116" Post Alum For 40" Deck
1	111228A	Square Tenderdeck
6	111231A	Triangular Tenderdeck
1	123320A	Curved Transfer Module to 40"
3	121948A	Kick Plate For 8" Rise
1	115228A	Driver Panel
1	116244A	Pipe Barrier
1	130390A	Double Swoosh Poly Slide, 64-72" Deck
1	123393B	Firepole, 48" & 56" Deck
1	122913A	Snake Climber, 48"-56" Deck
1	123284B	Wiggle Ladder, 40" Deck
1	119289A	84" Clatterbridge w/Handrails For 24-48" Decks
1	119805A	Single Beam Loop Horizontal Ladder, 84" Length
1	111357A	Chinning Bar, 1 Alum Post
1	120902A	Hand Hold / Leg Lift
1	111275A	Hand Loop Assembly
2	111276A	Rail Assembly
1	118089A	Loop Seats
1	100051D	8' Beam, 4 Place, Uncoated Chn, Galv. Legs Swing Unit
1	122792A	Coated Chain For Molded Bucket Seat (8')
2	100053A	Slash Proof Belt Seat
1	100054A	Molded Bucket Seat
1	100055A	Full BucketSeat

119214A	TuffTimber Edger, 4' Length
100626A	30" Galvanized Stake for TuffTimber

2.4.2 Playground Layout B

Playground Layout B shall be constructed at the Arena Trailhead and shall consist of the following:

Quantity	Model	Description
3	111404B	140" Post Alum For 64" Deck
1	111404C	132" Post Alum For 56" Deck
1	111404D	124" Post Alum For 48" Deck
3	111404E	116" Post Alum For 40" Deck
3	111404F	108" Post Alum For 32" Deck
1	111228A	Square Tenderdeck
6	111231A	Triangular Tenderdeck
1	123320C	Curved Transfer Module to 32"
4	121948A	Kick Plate For 8" Rise
1	115228A	Driver Panel
1	116244A	Pipe Barrier
1	123393B	Firepole, 48" & 56" Deck
1	124863E	SlideWinder 2 Poly Slide, 64" Deck
1	123538B	Loop Pole, 48" - 56" Deck
1	116249A	Vertical Ladder, 24"-32"Deck to Ground
1	123284B	Wiggle Ladder, 40" Deck
1	120310A	Belt Bridge, 84" for 24"-48" Decks
1	111471A	Horizontal Ladder Support, 2" Beam
1	119805A	Single Beam Loop Horizontal Ladder, 84" Length
1	111357A	Chinning Bar, 1 Alum Post
1	120902A	Hand Hold / Leg Lift
1	118089A	Loop Seats
1	100051D	8' Beam, 4 Place, Uncoated Chn, Galv. Legs Swing Unit
1	122792A	Coated Chain For Molded Bucket Seat (8')
2	100053A	Slash Proof Belt Seat
1	100054A	Molded Bucket Seat
1	100055A	Full Bucket Seat
	119214A	TuffTimber Edger, 4' Length
	100626A	30" Galvanized Stake for TuffTimber

2.4.3 Playground Layout C

Sherlock Park

Quantity	Model	Description
3	111404B	140" Post Alum For 64" Deck
2	111404C	132" Post Alum For 56" Deck
1	111404D	124" Post Alum For 48" Deck
7	111404E	116" Post Alum For 40" Deck
1	111228A	Square Tenderdeck
5	111231A	Triangular Tenderdeck
1	119646A	Triangular Tenderdeck, Extension
1	123320A	Curved Transfer Module to 40"
3	121948A	Kick Plate For 8" Rise

1	115228A	Driver Panel
2	116244A	Pipe Barrier
1	130390A	Double Swoosh Poly Slide, 64-72" Deck
1	123393B	Firepole, 48" & 56" Deck
1	123538B	Loop Pole, 48" - 56" Deck
1	123284B	Wiggle Ladder, 40" Deck
1	119289A	84" Clatterbridge w/Handrails For 24-48" Decks
1	119806A	Single Beam Loop Horiz. Ladder, 123" Length
1	111357A	Chinning Bar, 1 Alum Post
1	120902A	Hand Hold / Leg Lift, Coated Brown
1	111275A	Hand Loop Assembly
2	111276A	Rail Assembly
1	118089A	Loop Seats
1	100051D	8' Beam, 4 Place, Uncoated Chn, Galv. Legs Swing Unit
1	122792A	Coated Chain For Molded Bucket Seat (8')
2	100053A	Slash Proof Belt Seat
1	100054A	Molded Bucket Seat
1	100055A	Full Bucket Seat
	119214A	TuffTimber Edger, 4' Length
	100626A	30" Galvanized Stake for TuffTimber

2.4.4 Manufacturer Contact

The manufacturer of the playground equipment listed is provided below:

Manufacturer:
 Landcape Structures, Inc.
 601 7th Street South
 Delano, MN 55328
 (800) 328-0035
 (763) 972-3185 fax

Contact:
 Nancy Teel
 Earl F. Andersen Company
 (952) 884-7300
 (952) 884-5619 fax

PART 3 EXECUTION

3.1 SITE PREPARATION

3.1.1 Finished Grade and Underground Utilities

The Contractor shall verify that finished grades are as indicated; the smooth grading has been completed in accordance with Section 02300 EARTHWORK; installation of the underground utilities through the area has been completed in accordance with Section 02316 EXCAVATION, TRENCHING AND BACKFILLING FOR UTILITIES SYSTEMS; installation of the storm-drainage system through the area has been completed in accordance with Section 02630 STORM-DRAINAGE SYSTEM. The location of underground utilities and facilities in the area of the operation shall be verified. Damage to underground utilities and facilities shall be repaired at the Contractor's

expense.

3.1.1.2 Layout

The layout of the entire outdoor play area shall be staked before excavation begins to include the following: all play event configuration access and egress points; use zone perimeters; hard surface areas and pathway widths; exterior plant material and planters; walls and fences; and structures. Sufficient space shall be provided between all adjacent play events and individual play events for play activities and circulation. Moving and rotating play events shall be located away from circulation to prevent collisions.

3.1.1.2.1 Use Zone

The use zone is defined as the area beneath and immediately adjacent to a play structure or equipment that is designated for unrestricted circulation around equipment; and on whose surface it is predicted that a user would land when falling from or exiting the equipment, (paragraph CHILD SAFETY AND ACCESSIBILITY STANDARDS). Also, the use zone is associated with the following terms; "Clear Area," and "Fall Zone". The use zone shall be free of hard surfaces, objects or obstacles that a child could run into or fall on top of and be injured. The use zone shall consist of protective surfacing in accordance with the requirements of Section 02791 PLAYGROUND PROTECTIVE SURFACING. Use zone perimeters shall not overlap hard surfaces.

The use zone perimeter shall meet or exceed the requirements of paragraph CHILD SAFETY AND ACCESSIBILITY STANDARDS. Use zone perimeters shall not overlap except for certain play events as defined in ASTM F 1487.

3.1.1.2.2 Shop Drawings

When the use zone perimeter and play event configuration conflict with the requirements and paragraph CHILD SAFETY AND ACCESSIBILITY STANDARDS, shop drawings defining corrective measures shall be submitted to include the following: Adjustment to the play event with the use zone perimeter; use zone perimeter overlaps; hard surface area and pathway widths; structures; exterior plant material and planters; walls and fences; and bare or painted metal platform and slide bed orientation to the direct sun.

3.1.1.3 Orientation

Bare or painted metal platforms and slide beds shall be oriented from the direct sun; or shaded to reduce contact burn risk. Play events that require orientation to adjacent play events or to meet visibility requirements shall be properly oriented.

3.1.1.4 Obstructions Below Ground

When obstructions below ground affect the work, shop drawings showing proposed adjustments shall be submitted for approval.

3.2 INSTALLATION

Play events shall be installed according to the manufacturer's

recommendations and as shown to meet the requirements of paragraph CHILD SAFETY AND ACCESSIBILITY STANDARDS.

3.2.1 Play Event Modification

Site modifications of play events affect the coverage provided in paragraph WARRANTY; therefore, play events and equipment shall not be modified without the written approval of the manufacturer.

3.2.2 Wood Finish

Field applied or touch up of wood finishes shall meet the same specifications as finishes applied at the factory.

3.2.3 Plastic Play Events

Plastic and recycled plastic components shall be connected by stainless steel hardware. The hardware shall be countersunk. Recycled plastic molded as lumber or wood-polymer lumber shall be installed in accordance with the manufacturer's recommendations.

3.2.4 Footings

The top elevation of play event footings will be installed at the subbase of the protective surfacing.

3.2.5 Multiple-Axis (Rotating) Swing

The multiple-axis (rotating) swing shall be located away from other play events and circulation. It shall not be attached to a composite structure.

3.2.6 Single-Axis (To-Fro) Swing

The single-axis (to-fro) swing shall be located on the perimeter of the outdoor play area. It shall not be attached to a composite structure.

3.2.7 Slide

The required exit region clear area shall be provided in accordance with ASTM F 1487.

3.2.8 Chain or Rope Ladder, Climber or Net Climber

A chain or rope ladder; climber; net climber; and similar components shall be installed in the vertical position. Angled or arch positions are not accepted.

3.2.9 Composite Structure

The composite structure use zone perimeter shall be composed of the use zone perimeters of the play events that, when joined together, comprise the composite structure.

3.2.10 Fall Height

3.2.10.1 General

The fall height is defined as the vertical distance between the finished elevation of the designated play surface and the finished elevation of the protective surfacing beneath it. For some play events the fall height and paragraph PLATFORM HEIGHT are the same. For some play events the fall height and maximum equipment height are the same. When the furnished play event fall height varies from the play event shown, shop drawings defining the revised depth or type of protective surfacing to meet or exceed the requirements of Section 02791 PLAYGROUND PROTECTIVE SURFACING shall be provided.

3.2.10.2 Measuring Fall Height

EQUIPMENT	MEASURING FALL HEIGHT
Composite Structure:	For a platform surrounded by protective barriers, measure from the platform finished elevation.
	For a platform surrounded by guardrails, measure from the guardrail top elevation.
Infant Crawl Area:	A maximum 24 inch height, measured from the crawl wall or barrier finished elevation.
Playhouse, Nonclimbable:	Measure from the designated play surface finished elevation.
Spring Rocking Equipment:	Measure from the seat top elevation.
Stationary Equipment, Climbable:	Measure from the maximum equipment height finished elevation.
Stationary Equipment, Nonclimbable:	Measure from the designated play surface finished elevation.
Swing:	Measure from the bottom of the pivot point.

3.3 RESTORATION AND CLEAN UP

When the operation has been completed, the Contractor shall clean up and protect the site. Existing areas that have been damaged from the operation shall be restored to original condition at the Contractor's expense.

3.3.1 Clean Up

The site and play events shall be cleaned of all materials associated with the operation. Play events and surfaces shall be cleaned of dirt, stains, filings, and other blemishes occurring from shipment and installation. Cleaning methods and agents shall be as recommended by the manufacturer. Required labeling shall be undamaged and visible in accordance with paragraph EQUIPMENT IDENTIFICATION.

3.3.2 Disposal of Materials

Excess and waste material shall be removed and disposed off Government property.

3.4 PLAYGROUND ACCEPTANCE

3.4.1 Child Safety and Accessibility Evaluation

When the protective surfacing is installed the play events and protective surfacing shall be thoroughly inspected and measured to verify the playground meets manufacturer's recommendations, paragraph CHILD SAFETY AND ACCESSIBILITY STANDARDS, and paragraph FALL HEIGHT. The play events shall be age appropriate for the age group using them in accordance with paragraph PLATFORM HEIGHT. Determine 1) secure anchoring; 2) all hardware and connectors are tight; 3) all hardware and connectors require tools to loosen; 4) all hooks are closed; 5) head and neck entrapment; 6) sharp points, edges, and protrusions; 7) entanglement; 8) pinch, crush, and shear points; 9) suspended hazards; 10) all component holes are filled; and 11) recycled plastic components used as load bearing structural members. Use zone distances shall be measured to determine the area is free of hard surfaces, objects or obstacles. Determine exceptions to use zone overlaps occur in accordance with paragraph USE ZONE. Play event fall height shall be measured and compared to critical height value for thickness of installed protective surfacing. The slide exit region shall have the required clear zone. Play events and surfaces shall be properly oriented. Chain, rope, net climbers or similar components shall be installed in a vertical position. Swing seat clearances shall be measured while occupied by a maximum user for the age group using the equipment. Warning labels and manufacturer identification labels shall be visible in accordance with paragraph EQUIPMENT IDENTIFICATION. Play events that do not comply shall be reinstalled. Fasteners, anchors, hardware and labels that do not comply shall be replaced. Ensure positive drainage for the area and the lowest elevation of protective surfacing subgrade has been provided. A written report describing the results of the evaluation shall be provided.

3.4.2 Spare Parts

Standard play event and equipment spare parts provided by the manufacturer shall be furnished to the Contracting Officer.

3.4.3 Maintenance Instructions

The manufacturer's operation and maintenance manual describing the recommended preventive maintenance, inspection frequency and techniques, periodic adjustments, lubricants, and cleaning requirements shall be furnished.

3.5 RE-INSTALLATION

When re-installation is required, accomplish the following: Re-install the product as specified. Provide new replacement materials supplied by the manufacturer. Material acquisition of replacement parts is the responsibility of the Contractor. Damage caused by the failed installation shall be repaired at the Contractor's expense.

-- End of Section --

SECTION TABLE OF CONTENTS

DIVISION 02 - SITE WORK

SECTION 02920

SEEDING, SODDING, AND TOPSOIL

04/01

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 SUBMITTALS
- 1.3 SOURCE INSPECTION
- 1.4 DELIVERY, INSPECTION, STORAGE, AND HANDLING
 - 1.4.1 Inspection
 - 1.4.2 Storage
 - 1.4.3 Handling
 - 1.4.4 Soil Amendments

PART 2 PRODUCTS

- 2.1 SEED
 - 2.1.1 Seed Classification
 - 2.1.2 Permanent Seed Species and Mixtures
 - 2.1.3 Quality
- 2.2 SOD
 - 2.2.1 Quality
 - 2.2.2 Harvesting
 - 2.2.3 Delivery
- 2.3 TOPSOIL
- 2.4 SOIL AMENDMENTS
 - 2.4.1 Fertilizer
- 2.5 MULCH
 - 2.5.1 Straw Mulch
- 2.6 WATER

PART 3 EXECUTION

- 3.1 TURF PLANTING LOCATIONS, TIMES, AND CONDITIONS
 - 3.1.1 Notification
 - 3.1.2 Seed Locations
 - 3.1.3 Rates of Seeding
 - 3.1.4 Seeding Time
 - 3.1.5 Sod Locations
 - 3.1.6 Planting Conditions
- 3.2 SITE PREPARATION
 - 3.2.1 Finished Grade and Topsoil
 - 3.2.2 Spreading Topsoil
 - 3.2.2.1 Equipment

- 3.2.2.2 Stripped Materials
- 3.2.3 Tillage
- 3.2.4 Prepared Surface
- 3.3 SEEDING
 - 3.3.1 Equipment
 - 3.3.2 Broadcast Seeding
 - 3.3.3 Drill Seeding
 - 3.3.4 Hydroseeding (Optional)
 - 3.3.5 Mulching
 - 3.3.5.1 Hay or Straw Mulch
 - 3.3.5.2 Mechanical Anchor
 - 3.3.6 Initial Watering
 - 3.3.7 Native Grasses
- 3.4 SODDING
 - 3.4.1 Placement
 - 3.4.2 Rolling and Watering
- 3.5 RESTORATION AND CLEAN UP
- 3.6 MAINTENANCE
 - 3.6.1 Maintenance Watering
 - 3.6.2 Mowing
 - 3.6.3 General Maintenance
 - 3.6.3.1 Repair or Reinstall
 - 3.6.4 Maintenance Record
- 3.7 EVALUATION AND ACCEPTANCE
- 3.8 SURFACE EROSION CONTROL

-- End of Section Table of Contents --

SECTION 02920

SEEDING, SODDING, AND TOPSOIL

04/01

PART 1 GENERAL

Wherever possible, all seed shall be drilled. Other seeding methods are subject to approval. Existing turf areas which have been damaged during the contract operations, and which are outside of the limits designated to be seeded, shall be restored following the requirements in this section, at no additional cost to the Government.

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AGRICULTURAL MARKETING SERVICE (AMS)

AMS-01 (Aug 95) Federal Seed Act Regulations Part 201

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 4972 (1995a) pH of Soils

ASTM D 5268 (1992; R 1996) Topsoil Used for Landscaping Purposes

AMERICAN SOD PRODUCERS ASSOCIATION, INC. (ASPA)

ASPA (1988) Guideline Specifications to Sodding

MINNESOTA DEPARTMENT OF TRANSPORTATION (MNDOT) Standard Specifications for Construction (1995 EDITION AND SUPPLEMENTS)

MNDOT 3876 Seed

1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with SECTION 01330 SUBMITTAL PROCEDURES:

SD-01 Data

Manufacturer's Literature; FIO.

The Contractor shall submit manufacturer's literature discussing physical characteristics, applications, guarantees, and installation of the seed, mulch, and fertilizer. The Contractor shall submit manufacturer's literature for equipment showing application and installation instructions.

SD-08 Statements

Experience for Native Grasses; FIO.

The Contractor shall submit a statement indicating that the work to establish the turf will be supervised by an individual with a minimum of 5 years experience with establishment and restoration of native plant communities.

SD-09 Reports

Soil Test; FIO.

Certified reports of inspections and laboratory tests, prepared by an independent testing agency, including analysis and interpretation of test results. Each report shall be properly identified. Test methods used and compliance with recognized test standards shall be described.

Seed Test; FIO.

The Contractor shall submit test reports for a purity and germination test following the Association of Official Seed Analysts (AOSA) rules for each seed mixture. The test reports shall indicate the purity percentage, germination percentage, and amount of Pure Live Seed (PLS) per bag for each species.

Water Test; FIO

Water from sources other than municipal water supply shall be tested for salinity and pH.

SD-13 Certificates

Certificates of Compliance; FIO.

Prior to the delivery of materials, certificates of compliance attesting that materials meet the specified requirements. Certified copies of the material certificates shall include the following:

- a. Seed. Mixture percentage, percent pure live seed, percent germination, weed seed content, and date tested.
- b. Topsoil. Gradation, pH, organic matter content, textural class, soluble salts.
- d. Fertilizer. Chemical analysis and composition percent.
- e. Organic Material: Composition and source.
- g. Mulch: Composition and source.

SD-14 Samples

Samples; FIO

Samples shall be provided for the following:

- a. A 5 pound sample for each source of topsoil brought from off-site.
- b. A 2 pound sample for each type of soil amendment proposed for use.
- c. A 2 pound sample for each type of mulch proposed for use.

SD-18 Records

Quantity Check; FIO

Bag count or bulk weight measurements of material used compared with area covered to determine the application rate and quantity installed.

Maintenance Record; FIO

Maintenance work performed, area repaired or reinstalled, diagnosis for unsatisfactory stand of grass plants.

Seed Order for Native Grasses; FIO

Contractor shall submit proof of seed order for native grass seed mixes as specified within this section within 30 days of notice to proceed.

1.3 SOURCE INSPECTION

The source of delivered topsoil shall be subject to inspection.

1.4 DELIVERY, INSPECTION, STORAGE, AND HANDLING

1.4.1 Inspection

Seed shall be inspected upon arrival at the job site for conformity to species and quality. Seed materials shall be delivered in manufacturer's original, unopened containers with labels and tags intact and legible. Seed that is wet, moldy, or bears a test date five months or older, shall be rejected. Other materials shall be inspected for compliance with specified requirements. The following shall be rejected: open soil amendment containers or wet soil amendments; topsoil that contains slag, cinders, stones, lumps of soil, sticks, roots, trash or other material over a minimum 1-1/2 inch diameter; and topsoil that contains viable plants and plant parts. Unacceptable materials shall be removed from the job site.

1.4.2 Storage

Materials shall be stored on-site in areas provided by the Contractor. The storage areas shall be made accessible to the Contracting Officer so that application rates can be verified. Seed, lime, and fertilizer shall be stored in cool, dry locations away from contaminants. Chemical treatment materials shall be stored according to manufacturer's instructions and not

with seed.

1.4.3 Handling

Except for bulk deliveries, materials shall not be dropped or dumped from vehicles.

1.4.4 Soil Amendments

Soil amendments shall be delivered to the site in the original, unopened containers bearing the manufacturer's chemical analysis. In lieu of containers, soil amendments may be furnished in bulk. A chemical analysis shall be provided for bulk deliveries.

PART 2 PRODUCTS

2.1 SEED

Substitutions will not be allowed without written request and approval from the Contracting Officer. The mixing of seed may be done by the seed supplier prior to delivery, or on site in the presence of the Contracting Officer. Seed for native grass and forbe species shall be gathered from within 500 miles of the jobsite.

2.1.1 Seed Classification

State-certified seed of the latest season's crop shall be provided in original sealed packages bearing the producer's guaranteed analysis for mixture percentage, purity, germination, weed seed content, and inert material. Labels shall be in conformance with AMS-01 and applicable state seed laws.

2.1.2 Permanent Seed Species and Mixtures

Permanent seed species and mixtures shall be provided as follows:

- 1) Class 1, MNDOT 60A Modified
Turf Grasses
(New MNDOT 60B, Low Maintenance Turf)
- 2) Class 2, MNDOT 30A Modified
Upland Grasses
(New MNDOT 30B, Urban Prairie)
- 3) Class 2-WF, MNDOT 30A Modified with Forbs, Table F-1, NW Forbs
Upland Grasses with Forbs
(New MNDOT 30B-WF, Table F-1, NW Forbs, Urban Prairie with Forbs)
- 4) Class 3, MNDOT 25A Modified
Moist Condition Grasses with Forbs
(New MNDOT 25B, Prairie Sedge Meadow)

2.1.3 Quality

Weed seed shall be a maximum 1/2 of 1 percent by weight of the total mixture. Inoculant shall consist of the proper bacteria applied in the amount and manner recommended by the manufacturer to all legumes in the seed mix.

2.2 SOD

Sod shall be nursery grown as classified in the ASPA Guideline Specifications to Sodding. Sod shall be 100% mineral sod. Sod grown in peat soils will not be accepted. Sod shall consist of at least 75% Kentucky Blue Grass (*Poa pratensis*). Acceptable varieties include park, newport, glade, nugget, touch down, rugby, and parade.

2.2.1 Quality

Sod shall be machine cut at a uniform soil thickness of 5/8 inch, plus or minus 1/4 inch, at the time of cutting. Measurement of thickness shall exclude top growth and thatch. Standard size sections of sod shall be strong enough that when grasped at one end, can be picked up and handled without damage. Sod shall not be harvested or transplanted when moisture content, either excessively dry or wet, may adversely affect its survival. Broken pads and pads with torn or uneven ends will not be accepted. The pieces of sod shall not vary more than 1/2 inch in width.

2.2.2 Harvesting

Before harvesting, the turf shall be mowed uniformly at a height of 1 to 1-1/2 inches. Sod shall be harvested, delivered and transplanted within a period of 36 hours. Sod not transplanted within this time period shall not be installed without the inspection and approval of the Contracting Officer.

2.2.3 Delivery

Sod Pallets shall be sprinkled with water and covered with moist burlap, straw, or other approved covering and protected from exposure to wind and direct sunlight. Covering shall be such that air can circulate and heating will not develop.

2.3 TOPSOIL

Topsoil shall be as defined in ASTM D 5268. Topsoil shall be free from slag, cinders, stones, lumps of soil, sticks, roots, trash or other material over 1-1/2 inch diameter. Topsoil shall be free from viable plants and plant parts.

2.4 SOIL AMENDMENTS

Soil amendments required under this contract consist of fertilizer.

2.4.1 Fertilizer

The nutrients ratio shall be 20 percent nitrogen, 20 percent phosphorus, and 20 percent potassium. Fertilizer shall be controlled release

commercial grade, free flowing, and uniform in composition.

2.5 MULCH

2.5.1 Straw Mulch

Straw mulch materials shall consist of wheat, oat, or rye straw, hay, grass, or other plants approved by the Contracting Officer. Mulch materials shall be native to the region. The mulch material shall be air dry, reasonably light in color, and shall not be musty, moldy, caked, or otherwise of low quality. The mulch shall be seed free or fumigated to prevent introduction of weeds. The use of mulch that contains noxious weeds will not be accepted. Dry mulching material which breaks and does not bend is unacceptable. Mulch shall have a consistency for placing with commercial mulch blowing equipment.

2.6 WATER

Water shall be the responsibility of the Contractor, unless otherwise noted. Water shall not contain elements toxic to plant life.

PART 3 EXECUTION

3.1 TURF PLANTING LOCATIONS, TIMES, AND CONDITIONS

3.1.1 Notification

The Contractor shall notify the Contracting Officer 24 hours in advance of beginning seeding, sodding, or any changes in turf establishment operations.

3.1.2 Seed Locations

Seed shall be planted in locations indicated on the drawings and as listed below:

- 1) Class 1 - across the top of the levee, the levee slope on the dry side to the construction limits on the dry side of the levee, including the Arena Trailhead.
- 2) Class 2 - the levee slope on the wet side of the levee from the top of the slope to the toe of the levee.
- 3) Class 2 WF - from the toe of the levee on the wet side of the levee to the 820 contour on the wet side of the levee, including at the Murray Bridge Trailhead.
- 4) Class 3 - Below the 820 contour on the wet side of the levee including at the Murray Bridge Trailhead.

3.1.3 Rates of Seeding

Seed shall be applied at the rates listed below:

Seed Rates

Application Rate

Seed Rates

<u>Seed Mixture</u>	<u>(pounds per acre)</u>
Class 1	100
Class 2	60
Class 2-WF	60
Class 3	30

3.1.4 Seeding Time

Seed shall be planted within the dates specified below. No finished construction area shall be left untopsoiled and unseeded during the winter months. When substantially complete areas are not seeded within the specified seeding times for fall planting, a temporary winter cover shall be placed. Temporary winter cover shall be oats. Rate of seeding for oats as winter cover shall be 80 pounds per acre.

Seeding Time

Seed Mixture	Spring	Fall
Class 1	April 1 to June 1	July 20 to Sept. 20
Class 2	April 15 to July 20	Sept. 20 to Oct. 20
Class 2-WF	April 15 to July 20	Sept. 20 to Oct. 20
Class 3	April 15 to July 20	Sept. 20 to Oct. 20

3.1.5 Sod Locations

Sod shall be placed in locations indicated and on any disturbed areas outside of the limits of work.

3.1.6 Planting Conditions

Seeding and sodding operations shall be performed only during periods when beneficial results can be obtained. When drought, excessive moisture, or other unsatisfactory conditions prevail, the work shall be stopped when directed. When special conditions warrant a variance to the seeding and sodding operations, proposed alternate times shall be submitted for approval.

3.2 SITE PREPARATION

3.2.1 Finished Grade and Topsoil

The Contractor shall verify that finished grades are as indicated on drawings, and the placing of topsoil, smooth grading, and compaction requirements have been completed prior to the commencement of the seeding operation. All vegetation, including live roots, shall be completely removed or treated with herbicide prior to spreading topsoil or placing sod.

3.2.2 Spreading Topsoil

Topsoil shall be distributed and spread uniformly to one half the thickness shown on the plans and tilled to a depth of 2 inches into the subgrade.

The remaining half of the topsoil shall then be placed. Surface irregularities resulting from topsoiling or other operations shall be leveled to prevent depressions.

3.2.2.1 Equipment

Topsoil shall be spread using a bladed dozer having ground pressure less than 4.5 psi and operating weight less than 35,000 pounds, or with rubber tired equipment having operating weight less than 10,000 pounds. The work shall be coordinated such that equipment for hauling the topsoil does not travel over the topsoil in place. Areas compacted by construction operations shall be completely pulverized by tillage.

3.2.2.2 Stripped Materials.

Topsoil obtained from stripping operations shall be kept separate from other unusable excavated materials, brush, litter, objectionable weeds, roots, stones, and other materials that would interfere with planting and maintenance operations. Unusable material shall be removed and properly disposed of.

3.2.3 Tillage

Topsoil on slopes up to a maximum 3H:1V slope shall be tilled to a nominal 3 inch depth by plowing, disking, harrowing, rototilling or other approved method. On slopes between 3H:1V and 1:1, the soil shall be tilled to a minimum 2 inch depth by scarifying with heavy rakes, or other method.

3.2.4 Prepared Surface

The prepared surface shall be 1 inch below the adjoining grade of any surfaced area. New surfaces shall be blended to existing areas. The prepared surface shall be completed with a light raking to remove debris. Debris and stones over a minimum 1-1/2 inches in any dimension shall be removed from the surface. Drainage patterns shall be maintained as indicated on drawings. Tolerance for prepared surfaces shall be within 1 inch of the plan elevation. The prepared surface shall be protected from compaction or damage by vehicular or pedestrian traffic and surface erosion.

3.3 SEEDING

Prior to installing seed, any previously prepared surface compacted or damaged shall be reworked to meet the requirements of paragraph SITE PREPARATION. Seeding operations shall not take place when the wind velocity will prevent uniform seed distribution.

3.3.1 Equipment

Gravity feed applicators, which drop seed directly from a hopper onto the prepared soil, shall not be used because of the difficulty in achieving even coverage, unless otherwise approved.

3.3.2 Broadcast Seeding

In areas inaccessible to drill seeding, seed shall be broadcast by hand. Seed shall be uniformly broadcast at the rate specified for the mix. Half the total rate of seed application shall be sown with sower moving in one direction, and the remainder with sower moving at right angles to first sowing. Seed shall be covered a maximum 1/4 inch depth by disk harrow, steel mat drag, cultipacker, or other approved device. Seed shall not be broadcast when wind speed exceeds 5 miles per hour.

3.3.3 Drill Seeding

Seed shall be uniformly drilled to a depth of 1/2 to 3/4 inches at the rate specified for the mix. Equipment shall have drills a maximum 6 inches distance apart. Row markers shall be used with the drill seeder. Seed shall be drilled in two directions, applying approximately half the seed in each direction. The drilling equipment shall be maintained with half full seed boxes during the seeding operations. When slopes exceed 1 vertical on 5 horizontal, baffle plates spaced not more than 6 inches apart shall be installed in the seed box.

3.3.4 Hydroseeding (Optional)

The hydroseeding operation shall apply the seed, mulch, and fertilizer simultaneously. The seed shall be applied at the rate indicated in the Seed Mixture Table. The fertilizer shall be applied at a rate proposed by the Contractor and agreed to by the Contracting Officer. The mulch shall be applied at a rate of about 1 ton per acre. During application, the spray shall be directed to obtain a uniform material distribution as evidenced by a formation of a "blotter-like" cover, with about 5% void area. The mulch shall permit percolation of water to the underlying soil. The seed mixed with water and fertilizer shall be applied within 1 hour after adding to the tank.

3.3.5 Mulching

3.3.5.1 Hay or Straw Mulch

Hay or straw mulch shall be spread uniformly at the rate of 2 tons per acre, except as modified for native grasses. Mulch shall be spread by hand, blower-type mulch spreader, or other approved method. Mulching shall be started on the windward side of relatively flat areas or on the upper part of steep slopes, and continued uniformly until the area is covered. The mulch shall not be bunched or clumped. Sunlight shall not be completely excluded from penetrating to the ground surface. All areas installed with seed shall be mulched on the same day as the seeding. Mulch shall be anchored immediately following spreading.

3.3.5.2 Mechanical Anchor

Mechanical anchor shall be a V-type-wheel land packer; a scalloped-disk land packer designed to force mulch into the soil surface; or other suitable equipment.

3.3.6 Initial Watering

Watering shall be started immediately after completing the seeding of an area. Water shall be applied to supplement rainfall at a rate sufficient to ensure moist soil conditions to a minimum 3 inch depth. Run-off and puddling shall be prevented. Watering trucks shall not be driven over turf areas, unless otherwise directed by Contracting Officer.

3.3.7 Native Grasses

Hay or straw mulch shall be spread uniformly at the rate of 2 tons per acre. Areas seeded with native grasses, except slopes steeper than 3H:1V, shall be firmed with a roller not exceeding 90 pounds per foot roller width. Seed drills equipped with rollers are acceptable.

3.4 SODDING

3.4.1 Placement

Sod shall be carefully placed with the first row laid in a straight line and subsequent rows placed parallel to and abutted tightly against each other. Sod shall be placed with staggered end joints and without stretching or overlapping. On slope areas sodding shall be started at the bottom of the slope. On 1:3 or steeper slopes, sod shall be laid across the angle of the slope and secured by tamping, pegging or other approved methods of temporarily securing each piece. In areas where concentrated flow of water is expected, sod shall be laid at right angles to the flow. After the sodding operation has been completed, the edges of the sodded area shall blend smoothly into the surrounding area.

3.4.2 Rolling and Watering

After completion of the sod placement in each area, the Contractor shall water the sod immediately, and the entire area shall be lightly rolled. The sod shall be watered to a depth sufficient such that the underside of the sod pad and the soil immediately below the pad are thoroughly wet. Watering operations shall be properly supervised to prevent run-off. The Contractor shall arrange for an adequate water supply and all equipment necessary for water application shall be supplied including all pumps, hoses, pipelines, and sprinkling equipment until final acceptance is made.

3.5 RESTORATION AND CLEAN UP

Immediately upon completion of the seeding operation in an area, the area shall be protected against traffic or other use by erecting barricades, providing signage, or as directed by Contracting Officer. Existing turf areas, pavements, riprap areas and other project features that have been damaged from the seeding operation shall be restored to original condition at Contractor's expense. Excess and waste material shall be removed from the seeded areas and shall be disposed offsite. Adjacent paved areas shall be cleaned.

3.6 MAINTENANCE

3.6.1 Maintenance Watering

The Contractor shall be responsible for watering after planting to promote adequate growth and development. Water shall be distributed with equipment that does not erode or disturb the mulch. If the grass wilts, or if the soil becomes crusted and desiccated during germination, the Contracting Officer may direct watering. Watering directed by the Contracting Officer shall be performed within 48 hours after notice by the Contracting Officer to the Contractor; and shall place about 10,000 gallons per acre.

3.6.2 Mowing

- a. Bluegrass predominant seed mixes: Mowing shall be done as needed to maintain lawn areas at a nominal height of 3 inches until final acceptance, except not more than 1/3 of the grass leaf shall be removed by the initial cutting. Clippings shall be removed when the amount of cut turf is heavy enough to damage the turfed areas. Seeded areas shall be mowed immediately prior to final inspection.
- b. Native Grasses: Areas seeded with native grasses shall be mowed during the first growing season to control pioneering weeds and other competition. For the purposes of this project a weed is defined as any plant not included in the seed mix. Mowing should be done before the general height is 6 to 10 inches, or when the weedy foliar cover reaches 50 percent of the seeded area, or when the weed species begin to flower. The first mowing shall be set at a height of 3 inches with the following mowings to be set at a height of 4 to 8 inches. Rotary, flail, or sickle bar type mowing equipment is acceptable.

3.6.3 General Maintenance

Maintenance of the seeded areas shall include eradicating weeds, protecting embankments and ditches from surface erosion, maintaining erosion control materials and mulch, protecting installed areas from traffic, mowing, watering, and post-fertilization. If any portion of the surface becomes rilled, gullied, damaged, or destroyed, that portion shall be repaired to re-establish the area without additional cost to the government. The Contractor shall control erosion during the maintenance period by using ditch checks, sod swales, silt fences or other methods until a proper stand of turf is established.

3.6.3.1 Repair or Reinstall

Unsatisfactory stand of grass plants and mulch shall be repaired or reinstalled, and eroded areas shall be properly filled. Mulch material that has been removed by wind or other causes shall be replaced and secured. Maintenance shall include protecting embankments and ditches from erosion and maintaining erosion control material.

3.6.4 Maintenance Record

A record of each site visit shall be furnished, describing the maintenance work performed; areas repaired or reinstalled; and diagnosis for unsatisfactory stand of grass plants.

3.7 EVALUATION AND ACCEPTANCE

Turf establishment after seeding shall extend for 12 months after completion of the seeding on the entire project, unless desired growth is established, and shortening the period of the Contractor's responsibility for acceptably established areas is authorized by the Contracting Officer. Grass plants shall be evaluated for species and health when the grass plants are a minimum 1 inch high.

- a. Bluegrass predominant seed mixes. A stand of turf is defined as a uniform stand of grass that is at least 2 inches tall with a minimum of 100 grass plants per square foot and reasonably free of weeds and visual imperfections as assessed by the Contracting Officer.
- b. Native Grasses. A proper stand of turf from the seeding of native grasses is defined as a minimum of 10 plants per square foot and where no gaps larger than 6 inches in diameter occur anywhere in the turfed area. Only plants specified in the seed mix table will be considered.

3.8 SURFACE EROSION CONTROL

Where directed, surface erosion control material shall be installed in accordance with manufacturer's instructions. Placement of the material shall be accomplished without damage to installed material and deviation to finished grade. When directed by Contracting Officer and during contract delays affecting the seeding operation or when a quick cover is required to prevent surface erosion, the areas designated shall be seeded with a temporary seed crop.

-- End of Section --

SECTION TABLE OF CONTENTS

DIVISION 02 - SITE WORK

SECTION 02930

EXTERIOR PLANTING

04/01

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 SUBMITTALS
- 1.3 SOURCE INSPECTIONS
- 1.4 DELIVERY, STORAGE, AND HANDLING
 - 1.4.1 Delivery
 - 1.4.1.1 Plant Material Identification
 - 1.4.1.2 Protection During Delivery
 - 1.4.1.3 Conditioners and Amendments
 - 1.4.1.4 Pesticide Material
 - 1.4.2 Storage
 - 1.4.3 Handling
- 1.5 SCHEDULE
- 1.6 INSPECTION

PART 2 PRODUCTS

- 2.1 PLANT MATERIAL
 - 2.1.1 Tree Delivery
 - 2.1.2 Quality
 - 2.1.3 Method of Shipment to Maintain Health of Root System
 - 2.1.3.1 Balled and Burlapped (BB) Plant Material
 - 2.1.3.2 Bare-Root (BR) Plant Material
 - 2.1.3.3 Container-Grown (C) Plant Material
 - 2.1.4 Growth of Trunk and Crown
 - 2.1.4.1 Deciduous Trees
 - 2.1.4.2 Deciduous Shrubs
 - 2.1.4.3 Coniferous Evergreen Plant Material
 - 2.1.4.4 Ground Cover and Vine Plant Material
- 2.2 TOPSOIL
- 2.3 MULCH

PART 3 EXECUTION

- 3.1 PROTECTION OF EXISTING VEGETATION
- 3.2 PERCOLATION TEST
- 3.3 SITE PREPARATION
 - 3.3.1 Layout
- 3.4 INSTALLATION
 - 3.4.1 Setting Plant Material

- 3.4.2 Backfill Soil Mixture
- 3.4.3 Backfill Procedure
- 3.4.4 Staking and Guying
- 3.5 FINISHING
 - 3.5.1 Placing Mulch
 - 3.5.2 Pruning
- 3.6 MAINTENANCE DURING PLANTING OPERATION
- 3.7 RESTORATION AND CLEAN UP
- 3.8 PLANT ESTABLISHMENT PERIOD
 - 3.8.1 Commencement
 - 3.8.2 Maintenance During Establishment Period
 - 3.8.2.1 Watering Plant Material
 - 3.8.2.2 Weeding
 - 3.8.3 Unhealthy Plant Material

-- End of Section Table of Contents --

SECTION 02930

EXTERIOR PLANTING

04/01

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN NURSERY AND LANDSCAPE ASSOCIATION (ANLA)

ANLA/ANSI Z60.1 (1996) Nursery Stock

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A300 (1995) Tree Care Operations - Trees,
Shrubs and other Woody Plant Maintenance

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 4972 (1995a) pH of Soils

ASTM D 5268 (1992; R1996) Topsoil Used for Landscaping
Purposes

MINNESOTA DEPARTMENT OF TRANSPORTATION (MNDOT), STANDARD
SPECIFICATIONS FOR CONSTRUCTION (1995 EDITION AND SUPPLEMENTS)

MNDOT 2571 Plant Installation

MNDOT 3882 Mulch

1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having a "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-07 Schedules

Plant Installation Schedule; GA.

Plant installation schedule shall be submitted a minimum of 30 days before beginning plant installation. Schedule shall specify planting season (spring or fall), dates, locations, and plant materials to be installed.

SD-08 Statements

Plant Establishment Period; FIO.

The period for maintaining installed plant material in a healthy growing condition shall begin immediately after planting and shall be in effect for 12 months from the date of acceptance of planting operations in an area. Written calendar time period shall be furnished for the plant establishment period. When there is more than one plant establishment period, the boundaries of the planted area covered for each period shall be described.

SD-09 Reports

Percolation Test; FIO.

Test reports, prepared by an independent testing agency.

SD-18 Records

Maintenance Record; FIO.

A record shall be furnished describing the maintenance work performed, the quantity of plant losses, diagnosis of the plant loss, the quantity and date of replacements made, and pesticide application.

1.3 SOURCE INSPECTIONS

The nursery or source of plant material and the source of delivered topsoil shall be subject to inspection.

1.4 DELIVERY, STORAGE, AND HANDLING

1.4.1 Delivery

1.4.1.1 Plant Material Identification

Plant material shall be identified with attached, durable, waterproof labels and weather-resistant ink, stating the correct botanical plant name and size.

1.4.1.2 Protection During Delivery

Plant material shall be protected during delivery to prevent desiccation and damage to the branches, trunk, root system, or earth ball. Branches shall be protected by tying-in. Exposed branches shall be covered during transport.

1.4.1.3 Conditioners and Amendments

Soil conditioners and amendments shall be delivered to the site in the original, unopened containers bearing the manufacturer's chemical analysis and name. In lieu of containers, soil conditioners and amendments may be furnished in bulk and a certificate from the manufacturer indicating the

above information shall accompany each delivery.

1.4.1.4 Pesticide Material

Pesticide material shall be delivered to the site in the original, unopened containers bearing legible labels indicating the Environmental Protection Agency (EPA) registration number and the manufacturer's registered uses.

1.4.2 Storage

Plants stored on the work site shall be protected from any drying at all times by covering the balls or roots with moist sawdust, wood chips, shredded bark, peat moss, or other similar mulching material. Plants, including those in containers, shall be kept in a moist condition by watering with a fine mist spray until planted.

Storage of other material shall be in designated areas. Soil amendments shall be stored in dry locations and away from contaminants. Chemical treatment material shall be stored according to manufacturer's instructions and not with plants or other materials.

1.4.3 Handling

Plant material shall not be injured in handling. Cracking or breaking the earth ball of balled and burlapped plant material shall be avoided. Plant material shall not be handled by the trunk or stems. Materials shall not be dropped from vehicles.

1.5 SCHEDULE

Planting shall be scheduled within the dates in the Optimal Planting Date table shown on the drawings. When special conditions warrant a variance to the planting operations, proposed planting times shall be submitted for approval. Planting operations shall be performed only during periods when beneficial results can be obtained. When drought, excessive moisture, frozen ground or other unsatisfactory conditions prevail, the work shall be stopped when directed.

1.6 INSPECTION

Plants shall be subject to inspection at any time prior to planting. Plants may be inspected at the nursery prior to shipment, but such inspection shall not be considered as acceptance. Upon request of the Contracting Officer, the Contractor shall accompany the Government inspector to the nursery and identify plant material to be furnished. Unacceptable material shall be promptly removed from the job site.

PART 2 PRODUCTS

2.1 PLANT MATERIAL

2.1.1 Tree Delivery

Trees shall be delivered to the jobsite without wrapping (bark shall be

visible for inspection).

2.1.2 Quality

Well shaped, well grown, vigorous plant material having healthy and well branched root systems in accordance with ANLA/ANSI Z60.1 shall be provided.

Plant material shall be provided free from disease, harmful insects and insect eggs, sun-scald injury, disfigurement and abrasion. Plant material shall be free of shock or damage to branches, trunk, or root systems, which may occur from the digging and preparation for shipment. Plant material shall be well shaped, vigorous and healthy with a healthy, well branched root system. Plant material shall be checked for unauthorized substitution and to establish nursery grown status. The plant material shall exhibit typical form of branch-to-height ratio; and meet the caliper and height measurements specified. Plant material that measures less than specified, or has been poled, topped off or headed back, shall be rejected. Container-grown plant material shall show new fibrous roots and the root mass shall contain its shape when removed from the container.

2.1.3 Method of Shipment to Maintain Health of Root System

2.1.3.1 Balled and Burlapped (BB) Plant Material

Ball size and ratio shall be in accordance with ANLA/ANSI Z60.1. The ball shall be of a diameter and depth to encompass enough fibrous and feeding root system necessary for the full recovery of the plant. The plant stem or trunk shall be centered in the ball. All roots shall be clean cut at the ball surface. Roots shall not be pulled from the ground. Before shipment the root ball shall be dipped in gels containing mycorrhizal fungi inoculum. The root ball shall be completely wrapped with burlap or other suitable material and securely laced with biodegradable twine. Plant material with broken or cracked balls, or broken containers shall be rejected.

2.1.3.2 Bare-Root (BR) Plant Material

Minimum root spread shall be in accordance with ANLA/ANSI Z60.1. A well branched root system characteristic of the species specified shall be provided. Roots shall not be pulled from the ground. Bare-root plant material shall be inoculated with mycorrhizal fungi during germination in the nursery. Before shipment the root system shall be dipped in gels containing mycorrhizal fungi inoculum. Bare-root plant material shall be dormant. The root system shall be protected from drying out.

2.1.3.3 Container-Grown (C) Plant Material

Container size shall be in accordance with ANLA/ANSI Z60.1. Plant material shall be grown in a container over a duration of time for new fibrous roots to have developed and for the root mass to retain its shape and hold together when removed from the container. Container-grown plant material shall be inoculated with mycorrhizal fungi during germination in the nursery. Before shipment the root system shall be dipped in gels containing mycorrhizal fungi inoculum. The container shall be sufficiently rigid to hold ball shape and protect root mass during shipping.

2.1.4 Growth of Trunk and Crown

2.1.4.1 Deciduous Trees

A height to caliper relationship shall be provided in accordance with ANLA/ANSI Z60.1. Height of branching shall bear a relationship to the size and species of tree specified and with the crown in good balance with the trunk. The trees shall not be "poled" or the leader removed.

- a. Single stem: The trunk shall be reasonably straight and symmetrical with crown and have a persistent main leader.
- b. Multi-stem: All countable stems, in aggregate, shall average the size specified. To be considered a stem, there shall be no division of the trunk which branches more than 6 inches from ground level.

2.1.4.2 Deciduous Shrubs

Deciduous shrubs shall have the height and number of primary stems recommended by ANLA/ANSI Z60.1. Acceptable plant material shall be well shaped, with sufficient well-spaced side branches, and recognized by the trade as typical for the species grown in the region of the project.

2.1.4.3 Coniferous Evergreen Plant Material

Coniferous Evergreen plant material shall have the height-to-spread ratio recommended by ANLA/ANSI Z60.1. The coniferous evergreen trees shall not be "poled" or the leader removed. The leader shall be whole and unpruned, including the tip.

2.1.4.4 Ground Cover and Vine Plant Material

Ground cover and vine plant material shall have the minimum number of runners and length of runner recommended by ANLA/ANSI Z60.1. Plant material shall have heavy, well developed and balanced crown with vigorous, well developed root system and shall be furnished in containers.

2.2 TOPSOIL

Topsoil shall be as defined in ASTM D 5268. When available, the topsoil shall be the existing surface soil stripped and stockpiled onsite in accordance with SECTION 02300: EARTHWORK. When additional topsoil is required beyond the available topsoil from the stripping operation, topsoil shall be delivered and amended as recommended by the soil test for the plant material specified. Topsoil shall be free from slag, cinders, stones, lumps of soil, sticks, roots, trash or other material over a minimum 1-1/2 inch diameter. Topsoil shall be free from viable plants and plant parts.

2.3 MULCH

Mulch shall be shredded hardwood mulch in accordance with MNDOT 3882, Type 6 modified. Mulch shall be free from weeds, mold, and other deleterious materials. Rotted manure and recycled mulch including compost, plastics, or pine needles is not acceptable.

PART 3 EXECUTION

3.1 PROTECTION OF EXISTING VEGETATION

If turf areas have been established prior to planting operations, the surrounding turf shall be covered before excavations are made in a manner that will protect turf areas. Existing trees, shrubbery, and beds that are to be preserved shall be protected in accordance with the approved Environmental Protection Plan and SECTION 01000: GENERAL.

3.2 PERCOLATION TEST

Test for percolation shall be done to determine positive drainage of plant pits and beds. A positive percolation shall consist of a minimum 1 inch per 3 hours. If a negative percolation test occurs, no planting shall be continued in the area represented by the test until changes are directed by the Contracting Officer.

3.3 SITE PREPARATION

The Contractor shall verify that finished grades are as indicated on drawings, and that the placing of topsoil, the smooth grading, and the compaction requirements have been completed in accordance with SECTION 02300 : EARTHWORK, prior to the commencement of the planting operation. The location of underground utilities and facilities in the area of the planting operation shall be verified. Damage to underground utilities and facilities shall be repaired at the Contractor's expense.

3.3.1 Layout

Tree locations and bed outlines shall be staked by the Contractor on the project site and approved by the Contracting Officer before any plant pits or beds are dug.

3.4 INSTALLATION

3.4.1 Setting Plant Material

Plant material shall be set plumb and held in position until sufficient soil has been firmly placed around root system or ball. Balled and burlapped and container grown plants shall be handled and moved only by the ball or container. Plastic wrap and metal baskets shall be completely removed before the placement of backfill. Container grown stock shall be removed from containers without damaging plant or root systems. After centering the plant in pit, all ropes secured to the trunk shall be removed and burlap opened on top 1/3 of the root ball.

3.4.2 Backfill Soil Mixture

The backfill soil mixture may be a mix of topsoil and soil amendments suitable for the plant material specified. When practical, the excavated soil from the plant pit that is not amended provides the best backfill and shall be used. Mycorrhizal fungi inoculum shall be added as recommended by the manufacturer of the plant material specified.

3.4.3 Backfill Procedure

Prior to backfilling, all metal, wood, synthetic products, or treated burlap devices shall be removed from the ball or root system avoiding damage to the root system. The backfill procedure shall remove air pockets from around the root system. Plant pits and plant beds shall be watered immediately after backfilling, until completely saturated.

3.4.4 Staking and Guying

Staking will be required when trees are unstable or will not remain set due to their size, shape, or exposure to high wind velocity. Trees that are staked and guyed shall be completed as shown on the drawings.

3.5 FINISHING

3.5.1 Placing Mulch

Care shall be taken to avoid contaminating the mulch with the planting soil. Mulch shall be kept out of the crowns of shrubs, ground cover, and vines and shall be kept off buildings, sidewalks and other facilities.

3.5.2 Pruning

New plant material shall be pruned in accordance with recommended dates for each species in the following manner: prune dead and broken branches, cross branches, weak branches, and for shape. Typical growth habit of individual plants shall be retained with as much height and spread as is practicable. The pruning of trees shall be in accordance with ANSI A300. Clean cuts shall be made flush with the parent trunk. Improper cuts, stubs, dead and broken branches shall be removed. "Headback" cuts at right angles to the line of growth will not be permitted. Trees shall not be poled or the leader removed, nor shall the leader be pruned or "topped off". Trimming shall be disposed of as specified for clearing and grubbing debris in SECTION 01000: GENERAL

3.6 MAINTENANCE DURING PLANTING OPERATION

Installed plant material shall be maintained in a healthy growing condition. Maintenance operations shall begin immediately after each plant is installed to prevent desiccation and shall continue until the plant establishment period commences. Installed areas shall be kept free of weeds, grass, and other undesired vegetation. The maintenance includes maintaining the mulch, watering, and adjusting settling.

3.7 RESTORATION AND CLEAN UP

Turf areas, pavements and facilities that have been damaged from the

planting operation shall be restored to original condition at the Contractor's expense. Excess and waste material shall be removed from the installed area and shall be disposed offsite. Adjacent paved areas shall be cleared.

3.8 PLANT ESTABLISHMENT PERIOD

3.8.1 Commencement

The period for maintaining installed plant material in a healthy growing condition shall begin immediately after planting and shall be in effect for 12 months from the date of acceptance of planting operations in an area. Written calendar time period shall be furnished for the plant establishment period. When there is more than one plant establishment period, the boundaries of the planted area covered for each period shall be described. The plant establishment period shall be coordinated with SECTION 02920: SEEDING, SODDING, AND TOPSOIL. The plant establishment period shall be modified for separate completion dates for areas. Maintenance of seeded and sodded areas and of plants shall be in accordance with SECTION: 02935: EXTERIOR PLANT MATERIAL MAINTENANCE.

3.8.2 Maintenance During Establishment Period

Maintenance of plant material shall include straightening plant material, straightening stakes; tightening guying material; correcting girdling; supplementing mulch; pruning dead or broken branch tips; maintaining plant material labels; watering; eradicating weeds, insects and disease; post-fertilization; and removing and replacing unhealthy plants.

3.8.2.1 Watering Plant Material

The plant material shall be watered as necessary to prevent desiccation and to maintain an adequate supply of moisture within the root zone. All watering shall be done in a manner which will provide uniform coverage but which will not cause erosion or damage to the finished surface. Water shall not be applied with a force sufficient to displace mulch and shall not be applied at such a rate that it cannot be absorbed by the mulch and plants.

3.8.2.2 Weeding

Grass and weeds in the installed areas shall not be allowed to reach a maximum 3 inches height before being completely removed, including the root system.

3.8.3 Unhealthy Plant Material

A tree shall be considered unhealthy or dead when the main leader has died back, or up to a maximum 25 percent of the crown has died. A shrub shall be considered unhealthy or dead when up to a maximum 25 percent of the plant has died. This condition shall be determined by scraping on a branch an area 1/16 inch square, maximum, to determine if there is a green cambium layer below the bark. The Contractor shall determine the cause for unhealthy plant material and shall provide recommendations for replacement.

Unhealthy or dead plant material shall be removed immediately and shall be

replaced as soon as seasonal conditions permit.

-- End of Section --

SECTION TABLE OF CONTENTS

DIVISION 02 - SITE WORK

SECTION 02935

EXTERIOR PLANT MATERIAL MAINTENANCE

04/01

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 SUBMITTALS
- 1.3 DELIVERY, INSPECTION, STORAGE, AND HANDLING
 - 1.3.1 Delivery Schedule
 - 1.3.2 Storage
 - 1.3.3 Handling

PART 2 PRODUCTS

- 2.1 MULCH
- 2.2 WATER

PART 3 EXECUTION

- 3.1 MULCHING
- 3.2 WATERING
- 3.3 GENERAL MAINTENANCE REQUIREMENTS
 - 3.3.1 Maintenance Record
- 3.4 GRASS PLANT QUALITY
 - 3.4.1 Lawn Area
 - 3.4.2 Field Area
- 3.5 LAWN AND FIELD AREAS MAINTENANCE
 - 3.5.1 Mowing
 - 3.5.1.1 Lawn Areas
- 3.6 PLANT MATERIAL QUALITY
 - 3.6.1 General Requirements
 - 3.6.2 Growth of Trunk and Crown
 - 3.6.2.1 Deciduous Trees
 - 3.6.2.2 Deciduous Shrubs
 - 3.6.2.3 Coniferous Evergreen Plant Material
 - 3.6.2.4 Broadleaf Evergreen Plant Material
 - 3.6.2.5 Ground Cover and Vine Plant Material
- 3.7 SHRUB AND HEDGE MAINTENANCE
 - 3.7.1 Trimming and Pruning
 - 3.7.2 Irrigation of Shrubs and Hedges
 - 3.7.3 Shrub Fertilization Program
- 3.8 TREE MAINTENANCE
 - 3.8.1 Trimming and Pruning of Trees
 - 3.8.2 Irrigation of Trees

- 3.8.3 Unhealthy Plant Material
- 3.9 RESTORATION AND CLEAN UP
 - 3.9.1 Restoration
 - 3.9.2 Clean Up
- 3.10 CLEANING OF PAVED AREAS

-- End of Section Table of Contents --

SECTION 02935

EXTERIOR PLANT MATERIAL MAINTENANCE

04/01

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A300 (1995) Tree Care Operations - Trees, Shrubs and other Woody Plant Maintenance

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 602 (1995a) Agricultural Liming Materials

ASTM D 4972 (1995a) pH of Soils

ASTM D 5883 (1996) Use of Rotary Kiln Produced Expanded Shale, Clay or Slate (ESCS) as a Mineral Amendment in Topsoil Used for Landscaping and Related Purposes

MINNESOTA DEPARTMENT OF TRANSPORTATION (MNDOT), STANDARD SPECIFICATIONS FOR CONSTRUCTION (1995 EDITION AND SUPPLEMENTS)

MNDOT 2571 Plant Installation

MNDOT 3882 Mulch

1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having a "GA" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-08 Statements

Work Plan and Schedule; GA.

Contractor's work plan and schedule.

Maintenance Record; GA.

Contractor's record of each site visit.

Contractor's record of each site visit; FIO

SD-09 Reports

Soil Test; GA.Percolation Test; GA.

Certified reports of inspections and laboratory tests, prepared by an independent testing agency, including analysis and interpretation of test results. Each report shall be properly identified. Test methods used and compliance with recognized test standards shall be described.

1.3 DELIVERY, INSPECTION, STORAGE, AND HANDLING

1.3.1 Delivery Schedule

A delivery schedule shall be provided at least 10 calendar days prior to the first day of delivery.

1.3.2 Storage

Materials shall be stored in designated areas. Lime and fertilizer shall be stored in cool, dry locations away from contaminants. Chemical treatment material shall be stored according to manufacturer's instructions and not with seeding operation materials.

1.3.3 Handling

Except for bulk deliveries, materials shall not be dropped or dumped from vehicles.

PART 2 PRODUCTS

2.1 MULCH

Mulch shall be shredded hard wood mulch per MNDOT 3882, Type 6 modified. Mulch shall be free from weeds, mold, and other deleterious materials. Mulch materials shall be native to the region. Rotted manure shall not be used.

2.2 WATER

Water shall be the responsibility of the Contractor.

PART 3 EXECUTION

3.1 MULCHING

Mulch shall be mixed and applied in accordance with the manufacturer's recommendations.

3.2 WATERING

Water to supplement rainfall shall be applied at a rate sufficient to ensure plant growth. Run-off and puddling shall be prevented. Watering trucks shall not be driven over turf areas, unless otherwise directed. Watering of other adjacent areas or plant material shall be prevented.

3.3 GENERAL MAINTENANCE REQUIREMENTS

3.3.1 Maintenance Record

A record of each site visit shall be furnished, describing:

- a. Maintenance work performed.
- b. Areas repaired or reinstalled.
- c. Diagnosis for unsatisfactory stand of grass.
- d. Diagnosis for unsatisfactory stand of plant material in planting bed.
- e. Condition of trees.
- f. Condition of shrubs.
- g. Quantity and diagnosis of plant loss.
- h. Irrigation of system.

3.4 GRASS PLANT QUALITY

Grass plants shall be evaluated for species and health when the grass plants are a minimum 2 inches high. The living grass area shall be maintained to be uniform in color and leaf texture; and free from weeds and other undesirable growth. The living grass area shall be relatively free of thatch, diseases, nematodes, soil-borne insects, weeds or undesirable plants, stones larger than 1 inch in diameter, woody plant roots, and other materials detrimental to a healthy stand of grass plants. Broadleaf weeds and patches of foreign grasses shall be a maximum 2 percent of the total area.

3.4.1 Lawn Area

A satisfactory stand of grass plants for a lawn area shall be a minimum 100 grass plants per square foot. Bare spots shall be a maximum 6 inches square. The total bare spots shall be a maximum 2 percent of the total area.

3.4.2 Field Area

A satisfactory stand of grass plants for a field area shall be a minimum 10 grass plants per square foot. The total bare spots shall not exceed 2 percent of the total seeded area.

3.5 LAWN AND FIELD AREAS MAINTENANCE

3.5.1 Mowing

Seeded and sodded areas shall be mowed throughout the growing season to meet the requirements of paragraph GRASS PLANT QUALITY. Cutting height shall be adjusted according to type of grass. Mowing schedule shall be coordinated with the Contracting Officer. Frequency of mowing shall be adjusted so that no more than 1/4 of the leaf length is removed during a cutting.

3.5.1.1 Lawn Areas

Lawn areas shall be mowed to a minimum 2-inch height when the turf is a maximum 3-inches high. Remove clippings when the amount cut prevents sunlight from reaching the ground surface.

3.6 PLANT MATERIAL QUALITY

3.6.1 General Requirements

Plant material shall be identified as native to the region of the site or as a specimen. Plant material shall be maintained as well shaped, well grown, vigorous plant material having healthy root systems. The plant material shall be maintained as free from disease, harmful insects and insect eggs, sun-scald injury, disfigurement and abrasion. Plant material shall be free of shock or damage to branches, trunk, or root systems. Plant quality is determined by the growing conditions; climate and microclimate of the site for maintaining a healthy root system; and growth of the trunk and crown as follows.

3.6.2 Growth of Trunk and Crown

3.6.2.1 Deciduous Trees

Deciduous tree height to caliper relationship shall be maintained. Height of branching shall bear a relationship to the size and species of the tree and with the crown in good balance with the trunk. The trees shall not be "poled" or the leader removed.

- a. Single stem: The trunk shall be reasonably straight and symmetrical with crown and have a persistent main leader.
- b. Multi-stem: To be considered a stem, there shall be no division of the trunk which branches more than 6 inches from ground level.
- c. Specimen: The tree shall be well branched and pruned naturally according to the species. The form of growth desired, which may not be in accordance with natural growth habit, shall be indicated.

3.6.2.2 Deciduous Shrubs

Deciduous shrub height to number of primary stems shall be maintained. Shrubs shall be maintained as well shaped, with sufficient well-spaced side

branches, and recognized by the trade as typical for the species grown in the region of the site.

3.6.2.3 Coniferous Evergreen Plant Material

Coniferous evergreen plant material height-to-spread ratio shall be maintained. The coniferous evergreen trees shall not be "poled" or the leader removed. The plant material shall be maintained to be well shaped and trimmed to form a symmetrical and tightly knit plant. The form of growth desired shall be indicated.

3.6.2.4 Broadleaf Evergreen Plant Material

Broadleaf evergreen plant material height-to-spread ratio shall be maintained. The plant material shall be shaped to be recognized by the trade as typical for the variety grown in the region of the site.

3.6.2.5 Ground Cover and Vine Plant Material

Ground cover and vine plant material shall be maintained to have a heavy, well developed, and balanced crown with vigorous, well developed root system.

3.7 SHRUB AND HEDGE MAINTENANCE

3.7.1 Trimming and Pruning

Trimming shall be performed to ensure the following:

- a. Safety.
- b. Quality (size, height, and shape).
- c. Health (removing broken, diseased branches).
- d. Rejuvenation (removing one third to one half of the older stems or branches).
- e. Visibility (signs, building entrances, motorist line of sight).

Shrubs shall be pruned to the requirements of paragraph PLANT MATERIAL QUALITY. Pruning shall be accomplished by trained and experienced personnel in accordance with ANSI A300. The typical growth habit of individual plant material or the theme shape of the hedge shall be retained. Clean cuts shall be made flush with the parent trunk. Improper cuts, stubs, dead and broken branches shall be removed.

3.7.2 Irrigation of Shrubs and Hedges

Run-off, puddling and wilting shall be prevented.

3.7.3 Shrub Fertilization Program

A regular program of fertilization shall be established to include a fall

feeding to meet the requirements of paragraph PLANT MATERIAL QUALITY. Use industry standards for foliage and root fertilizing the plant material inventoried.

3.8 TREE MAINTENANCE

3.8.1 Trimming and Pruning of Trees

Trimming shall be performed to ensure the following:

- a. Safety.
- b. Quality (size, height).
- c. Health (removing broken, diseased wood branches).
- d. Rejuvenation (removing one third to one half of the older stems or branches).
- e. Visibility (signs, building entrances, motorist line of sight).

Trees shall be pruned to meet the requirements of paragraph PLANT MATERIAL QUALITY. Pruning shall be accomplished by trained and experienced personnel in accordance with ANSI A300. The typical growth habit of individual plant material shall be retained. Clean cuts shall be made flush with the parent trunk. Improper cuts, stubs, dead and broken branches shall be removed. "Headback" cuts at right angles to the line of growth will not be permitted. Trees shall not be poled or the leader removed, nor shall the leader be pruned or "topped off".

3.8.2 Irrigation of Trees

Run-off, puddling and wilting shall be prevented.

3.8.3 Unhealthy Plant Material

A tree shall be considered unhealthy or dead when the main leader has died back, or up to a maximum 25 percent of the crown has died. A shrub shall be considered unhealthy or dead when up to a maximum 25 percent of the plant has died. This condition shall be determined by scraping on a branch an area 1/16 inch square, maximum, to determine if there is a green cambium layer below the bark. The Contractor shall determine the cause for unhealthy plant material and shall provide recommendations for replacement. Unhealthy or dead plant material shall be removed immediately.

3.9 RESTORATION AND CLEAN UP

3.9.1 Restoration

Existing turf areas, pavements, and facilities that have been damaged from the maintenance operations shall be restored to original condition at Contractor's expense.

3.9.2 Clean Up

Excess and waste material shall be removed from the maintenance areas and dispose off site. Adjacent paved areas shall be cleaned as determined by the Contracting Officer.

3.10 CLEANING OF PAVED AREAS

Grass, weeds, leaves, and debris from mowing, clipping, and pruning shall be removed immediately. Excess and waste material shall be removed from paved areas and disposed off site. Debris, leaves shall be removed weekly.

-- End of Section --